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EDITORIAL NOTES—GAS, &c.

To Aid Sulphate of Ammonia.

NEVER have the Sulphate of Ammonia Committee had a meeting that should be more effective in producing additional subscribers than the one that was held towards the close of last month, the proceedings at which are reported in other columns to-day. We cannot imagine any manufacturer of sulphate of ammonia or any producer of ammoniacal liquor who, after reading the report of the proceedings, can decently, or with any dignity, go on pocketing the profits from ammoniacal liquor and sulphate of ammonia, and still stand aloof from, and refuse to contribute anything to, the propaganda work of the Committee. This work—financed by some and benefiting all—has grown at home. It has risen from the commonplace in advertising to a campaign carried on systematically and scientifically. Apart from the work on ordinary lines, the Committee carry their active influence right on to the land of the farmer, so that he may see, and, seeing, may believe. They send their technical emissary into farmers' clubs to deliver lectures, bearing with him authority to offer prizes for the best crops grown with sulphate of ammonia as the fertilizer. The home geographical limits have been broken through. There is the export trade; and, in developing it, our home Committee are working co-operatively with Germany, France, Belgium, and America. Each country can look after its home propaganda; but in the distant lands co-operation provides the most economical and efficient form of making known the merits of the commodity.

The meeting of the Committee on this occasion had an international tone about it; for from the countries mentioned there were representatives, who gave eloquent accounts of the success of work that is financed with liberality and with a business perspicacity. Every ton of sulphate of ammonia produced in Germany shares in the expenses of the propaganda work, though the levy is 2s. 9d. per ton (or thereabouts), and even Belgium manufacturers supply 1s. 10d. But in this country out of a production of 370,000 tons of sulphate of ammonia, only about 230,000 tons pay tribute to propaganda and protection, and then only at the rate of 7d. per ton. It is a peculiarity of the British gas industry, and of those other industries that produce secondary products of the character of those of the gas industry, that they hesitate so largely to do what is found so successful and productive in other branches of commerce—spend money upon advertising, and propagating knowledge of, their commodities. We have seen what Germany is now doing in this way; but there is something else that should be noted. It is that Germany's home consumption of sulphate of ammonia last year increased by nearly as much as the figure representing our total home consumption; and Germany to-day is about absorbing its entire native output. That is excellent. But, in consequence, is Germany slackening off in its propaganda work? Not a bit of it. Germany knows much better. There are competitors in the field; there are prices to be maintained, and prices to be pushed up if possible by enlarging the demand; and every year yields its increase of sulphate of ammonia. The world's increase last year was between 106,000 and 112,000 tons. We have something to learn from our friends of those countries who with us are the chief sulphate of ammonia producers of the world.

The Sulphate of Ammonia Committee claim, and they have a perfect right to the claim, considering the increase of production, that it is due to the demand-creative work they have accomplished that prices have been maintained at the level that makers have for some time past enjoyed. We cannot but agree, too, when reading the reports of prominent dealers in the sulphate of ammonia market, that international propaganda work has been mainly, if not wholly, responsible for the splendid prices that have recently been paid for sulphate of ammonia, and for the level at which prices are to-day. We cannot understand how any chairman of a gas company can meet the shareholders, and say that "sulphate of ammonia has served us well," while he is conscious that he has, by voice and vote, debarred the company from doing their part in furthering those conditions that have produced or maintained the excellent returns. The Committee again invite those sulphate of ammonia makers who, whether deliberately, or through insufficient thought, or from any other reason, have not become subscribers to do so. They also invite producers of ammoniacal liquor who do not work it up into sulphate of ammonia to become subscribers, on the basis of a contribution of 7d. per million cubic feet of gas made. They are not asking for more contribution per ton, though the South Metropolitan Gas Company are quite prepared, if need be, to go up to a contribution of 2s. 6d., or even 2s. 9d. per ton of sulphate in the furtherance of the cause. What the Committee want is to get additional money for their educational and advertising enterprises by bringing in the tonnage that does not so far contribute. That is all. We hope there will be a good response. If there is any mistaken notion in any makers' minds that the Committee attempt in any way to rule market prices, that idea may be set on one side. All they are doing, so far as prices are concerned, is to strengthen the support under them, and to increase the height of that support, not by fictitious means, but by sound constructional work.

Continental Gas Affairs.

THERE is always interest in learning how contemporary gas business is faring on the Continent, in order to contrast it with the experiences in this country. The report of the Directors of the Imperial Continental Gas Association and the pellucid speech of the Chairman (Mr. J. Horsley Palmer) always supply material for a comparison to be made. As a rule, it is found that the gas business in a half year in Germany and France has followed much the same lines as in this country; and it is so on this occasion, excepting in one particular. The consumption of gas grows; the Association netting an increase of no less than 7·11 per cent. over the whole of their mammoth operations, and additional consumers were connected up representing in the aggregate 9·07 per cent. These figures are exceedingly good, and show the vitality of the gas business with our Continental neighbours. But where the parallel fails is in the experiences of the coke market during the second half of last year. At home, coke took a distinguished place in the half-year's trading, and in its contribution to the revenue. In Germany, it was the contrary. Sales and prices were not so good as usual—atmospherical conditions being apparently solely responsible for this. Prices had to be put at a tempting level; and the final result was that an average saving of 4½d. per ton of coal was swept away, and 2d. besides, by the lower revenue received from coke. However the coke business has been stimulated during the opening months of this year by the lower temperature conditions. There were one or two other points in the speech of the Chairman upon which a little emphasis may be laid, in order to show more clearly how excellently the technical and commercial staffs have been working. The part of the winter embraced in the period covered by the present report, the Chairman tells us, was abnormally mild. This being so, it speaks volumes for the manner in which the applications of gas are growing that there should have been an increase in the amount of gas sold equal to 7·11 per cent. Seeing that this increase is represented by something like 400 million cubic feet, and that this was met by the carbonization of an additional 29,000 tons of coal, it exhibits excellent working on the part of the technical staff. A ton of coal does much more now for the Imperial Continental Gas Association than it did a few years ago—thanks to technical ability and improved methods and plant.

Erratic Results from Suction-Gas Plants.

We hope the paper that Mr. J. Emerson Dowson read recently before the Institution of Mechanical Engineers will not be overlooked by our readers, who in these days have to be primed on all possible subjects relating to competition of whatever kind. The paper (the principal parts of which were published last week) contained a considerable amount of information about suction-gas and pressure-gas producers; and such plants are very seductive competitors in the power field until people get to know them and their shortcomings. If ever there was proof that fuel cheapness is a highly persuasive force among manufacturers without having regard to the collateral or incidental expenses and disadvantages entailed, that proof is to be obtained in the fairly large adoption that suction and pressure gas plants have had on the most slender of representations. It is a fact that only in those industrial towns where gas is sold at a low price for power, have the gas undertakings been able to keep the suction or the pressure gas plant entirely beyond their bounds. On the other hand, there are instances of, after experience with such plants by manufacturers, lower price town gas having been able to recapture custom, or having stopped the extended adoption of such plants.

After all the years of use of suction and pressure gas plants, there was heard, at the meeting of the Mechanical Engineers, the cry for more facts and figures, and facts and figures established under actual working conditions. The manufacturers must see from this, they must know, too, from experience, that it is a very general view that the figures they have hitherto published have been found wanting, and that there exists a very large disbelief in them. The fuel cost per B.H.P. is insufficient; figures that only take notice of the best efficiencies at full loads are of little or no use to a manufacturer, the character of whose work being intermittent and variable does not give to his engine the load to maintain the efficiencies quoted by the plant makers. The figures they quote are akin to laboratory results, which makers know full well have really no similitude with daily working conditions. The contributors to the inefficiency of the suction-gas and pressure-gas plants are not to be found in a gas-engine plant supplied with town gas. A variable load makes no difference to the composition or quality of the town gas, a variable load does not make any pronounced difference in engine efficiency, town gas does not foul the engines as does the gas from the suction-gas plant, less labour is required for cleaning the engine connections and valves, there is no starting-up or clinkering to be done, no letting-down for the repair of the producer, no stand-by losses, no starting-up losses. Experience has, however, produced for the makers a shoal of difficulties; and they can only be eliminated by making the plants more complicated than formerly. If it is desired to secure something like uniformity in the character of the gas produced at variable loads, this can only be effected by an automatic regulation of the air and steam drawn into the generator; and this, and to properly proportion the amount of the air and the steam drawn in, means complication. For the removal of the tarry vapours, extractors have been tried; but it is considered by Mr. Emerson Dowson that it would be better if means were devised for getting rid of these in the producer itself. The necessity for cooling the gas before it reaches the engine cylinder has also added to what are happily termed "improvements" in the plants. But all such "improvements" are really departures from the extremely simple and demure plants that first came on to the market to court the favour of the manufacturer. The overcoming of difficulties, and the attempt to overcome others, have put quite a new character upon the plants as compared with their original state; and the difficulties have not yet been all successfully negotiated.

As pointed out, the variable quality of the gas, caused not only by the differences in the character of the fuel used, but by the variable loads at which the plants are worked, has a marked effect on efficiency. The tabulated analysis and the calorific power results that Mr. Emerson Dowson includes in his paper are very instructive. It is seen that the gas made in the pressure plants is of better quality for engine use than that made in the suction-gas plants; and it is also seen that the best gas for engine use is made when the producer is being worked at, or nearly at, its maximum capacity. The several analyses are well worth study in this regard. There is indeed quite marked depreciation in the gas when the plant is not being worked at its maximum load. The percentages of carbon monoxide and hydrogen are less; the percentages of carbon dioxide and nitrogen are higher. The calorific power of the gas is consequently lower. Confirmation of load affecting gas quality is found in all the tests; and there is no doubt whatever that the difference centres in a question of temperature—that is to say, it is only when the plant is being worked at or about its maximum load, that the temperature in the producer is maintained at the most desirable point; and it is only then, too, that the proportions of steam and air will have anything like correct relation. But these variations in quality make a distinct difference in the power of the engine. It is just as well to bear points of this kind in mind, in order that quoted minimum or partial costs and maximum efficiencies may not go unchallenged when met with in competition in the commercial field.

Value of High Pressure Distribution.

High-pressure gas distribution has now become quite an established practice in the economies and service of gas undertakings. Through it many large parts of existing distribution systems have obtained a new lease of life, much capital expenditure has already been saved, it has enabled gas undertakings to stretch their limbs to out-districts formerly isolated from gas supply, it has rehabilitated pressures where the growth of business had produced such drafts on the mains that pressures had been reduced, and it has enabled the simplification of complex conditions that were beginning to sorely vex the souls of many gas engineers. "Necessity "is the mother of invention;" and it is a very good thing, in the interests of progress, that compulsion sometimes comes along to serve as the propelling power to the devising and the application of new systems. This high-pressure practice is a case in point; and it has put a new power and a greater elasticity in the possession of gas undertakings, as well as added to the barriers of defence against competitors, who find dissatisfied gas consumers the most easy converts. It is interesting to reflect, as a new practice of the kind is under consideration, how richly creative and recuperative the gas industry has proved itself to be under the many and various phases of change that development and competition have between them brought about.

The subject of high-pressure distribution is cropping up with increased frequency at the meetings of the District Associations; but we do not think there has been a more exhaustive or a more helpful paper on the subject of both high and low pressure distribution schemes read before any of the Associations than the one that was presented by Mr. F. C. Willis at the meeting of the North of England Gas Managers' Association on Saturday last—being descriptive of the extensive work, in connection with two separate schemes of distinctive features, that has been carried out at Tynemouth by Mr. William Hardie, the Chief Engineer of the North Shields and Tynemouth Gas Company. The tangible advantages derived from the initial scheme led to the substantial extensions described in the paper. The success has been continued; among other gains being the carrying of the Company's activities into territory where, without the economical means of transit provided by the mechanical handling of gas, it would have been unprofitable for them to go. The description of the plant and methods adopted is given by Mr. Willis with such abundant detail that, within the compass of an editorial comment, no useful purpose would be served by directing attention to any one or a few of the points. Indeed, the details of a high-pressure scheme must be, as the schemes in the paper show, largely governed by the set of conditions under which it is to be employed.

There is, however, one matter of general interest apart from detail, and that is as to the effect of high pressures upon illuminating power and calorific value. Some preliminary tests have been carried out at Tynemouth; but Mr. Willis is careful to suggest that these must not be taken as conclusive, until there has been further opportunity for investigation. For what they are worth, however, they confirm previous observations, that the effect of high pressures upon the two recognized qualitative properties of gas is not of a *pari passu* order—that the effect upon calorific power is less than upon illuminating power. That is an advantage in view of the rising importance of the former, and the descending importance of the latter. The question was briefly referred to in the paper that Mr. R. M. Searle read at the meeting of the Institution of Gas Engineers, in

Dublin, in 1907; and allusions to it in the discussion, and on various occasions since, indicate that knowledge on the subject is not of a very positive nature. We hope that Mr. Hardie will have this matter thoroughly investigated—if possible at different pressures, and with mixed coal and carburetted water gas, and coal gas alone—and give the results to the gas industry. There have been several experiments made at various places; and we should like to hear more about them, seeing that the results that have been made known are not so definite as is desirable. But such information as is at command shows an insignificant depreciation in comparison with the advantages of high pressures in distribution.

Association and Gas Supply Work in South Wales.

MODESTY is no doubt a very good virtue—in its place; but when men bind themselves together with certain aims and objects, if they, in their modesty, refrain from any contribution to the attainment of the ends in view their combination is shorn of the main part of its value. The Welsh Institution has produced some excellent technical work in the past, its lines are laid in the right places, and there is the prospect of much usefulness being performed in various directions through the organization. All that is good. But we do regret to see that there seems a disposition to leave things very much to the few willing workers. We hope that the appeal for a more active participation in the work that Mr. Thomas Canning made to the members at their meeting last Wednesday will fall on good ground, and bear the desired fruit. The mainsprings of the Association are strong and sure; and there is plenty of initiative about them if there is support in giving effect to their proposals. No recognition was more richly deserved than the tangible one the members made to their Hon. Secretary (Mr. Octavius Thomas) last week; for he has been the active central driving force of the organization from its inception. The gas engineers and managers of the district all appear to be glad enough to belong to the Association; but the majority ought not to leave the work, practically speaking, entirely upon the shoulders of a few.

Therefore it is hoped that the proceedings at future meetings will bring some fresh productions to the front, and wider expression of thought and views from the members generally. In addition to the ordinary work of the Association, there is the Special Purposes Section, in connection with which the representatives of gas undertakings who become members of the section have private conference on both commercial and technical subjects. This is an invaluable opportunity in these competitive times, as it enables the private dissemination through the area of information that it is valuable to have in one's possession. We hope to hear of this section, now that there is a larger knowledge of its objects, becoming an important factor in the work of the Association. In another direction are found the efforts of the Association in arranging technical classes for juniors and classes for gas-fitters in the large district embraced by the organization. Endeavours have so far only met with partial success. There is every satisfaction with what has been effected for Cardiff and the district; but, so far as other parts are concerned, the chief difficulty appears to be—and this is an important matter in such a district as South Wales—to procure men with the qualifications essential to the making of efficient teachers. A man may be richly endowed with technical ability and knowledge, but he may make a very poor teacher. A man may pride himself on his erudition in these matters. In the class-room he may be respectfully listened to by those present; a few yards outside the door of the class-room, he may be the laughing-stock of the practical men who attend his classes. The teacher must have many qualifications; and the difficulty in South Wales is to get teachers whose heads, hands, and experience can contribute to the competence that is necessary. But there are brighter prospects of something more being done next season than has been done in Cardiff only.

The technical proceedings at the meeting may be said to have been of a twofold character. There was, in the first place, further consideration of the paper that Mr. Thomas Canning read at a previous meeting, on the "Thermal and Thermo-" Dynamic Efficiency of Town Gas in Practice." The chief interest will be found in the comparative costs that Mr. Canning has now furnished for gas and steam engines and electric motors per brake horse power per hour. The figures, at the prices quoted for gas, show well against the competitors; and they are confirmed both by practice and by the costs published by previous investigators. A fraction of a penny difference per brake-horse-power-hour between one form of fuel and another may not seem much to a manufacturer; it is the total difference (under a given set of conditions) at the end of twelve months' running that impresses. A point that is often overlooked in discussions of this question was referred to by Mr. Canning. It is that, in his trials, he had found the gas-engine he used, working at only about one-half of its rated capacity, did as much work as an electric motor working at its full rated capacity. At the rate at which developments are being made—with Professor Bone and his coadjutors transferring nearly the whole of the thermal value of gas to water in a boiler for the purpose of steam-raising—we shall soon have to be considering, under every set of circumstances, whether it will be better to use the gas in boiler-tubes packed with refractory material or direct in the cylinder of an engine. Power problems were never more interesting than they are at the present time; but what is urgently wanted is the spread of knowledge among the users of power, in order that they may not base their decision and choice on fuel costs alone, but take into account the many other factors that weigh in the final working result.

The other side of the technical part of the proceedings at the meeting was the visit to the Powell-Duffryn Steam Coal Company's coke-oven plant. There is a large amount of interest attaching to this plant, as we should imagine that, up to the present time, there is more of the residual gas from this plant utilized for domestic purposes than from any other coke plant in the country. It is a gas that comes out well on analysis, and has a good calorific power. But its candle power is below what is admissible under present inexorable requirement; and it has to be enriched by benzol. It would be quite good enough as it is for anything but flat-flame burners. Those who talk of positive relationship between illuminating power and colorific power, other than under comparable coal and carbonizing conditions, will do well to make a note of the existence of an 8½-candle power gas that has a calorific value of 460 B.Th.U. gross. In Germany they boast of the use of a gas of 10 to 12 candle power tested by the "Metropolitan" No. 2 burner, but of good calorific value; and it would not be impossible—if it were not a breach of confidence—to say something about a gas supply in this country of about 10-candle power, but with a thermal value equal to what is found in Berlin.

Washing Gas while Hot.

Any reasonable and simple means by which the sulphur compounds in gas could be reduced would be welcomed by all gas manufacturers. Mr. G. M. Gill has been making a search into the recorded work of the past in this connection; and one thing that has struck him is that, though elaborate experiments have been made in scrubbing gas after condensation, nothing much appears to have been done in scrubbing gas while still hot, and with hot ammoniacal liquor, with a view to lowering the sulphur compound content. In an article in another column, Mr. Gill supplies the main "findings" of his investigation into the technical record bearing on the subject; and he also gives some account, for what it is worth, of a little trial he has made with the simple means at command, and without pretensions at scientific accuracy. He does not place any particular value upon this trial, excepting in so far as the results provide encouragement to further experimental work, supplemented by the hope that the relation of the experience will bring from any others who may have carried out investigations in the same line an account of their experiences and the methods adopted. A narrative of work such as that before us is of the kind that is useful in its suggestiveness. Even if nothing of real value eventually comes out of it, it shows that something practical has been attempted in the particular direction. All that Mr. Gill has experimentally done has been to arrange that the liquor made in the retort-house (which is fairly free from carbonic acid and sulphuretted hydrogen) should be collected and circulated through the hydraulic main. The liquor is used over and over again at practically the same temperature as the gas; only the surplus being allowed to flow away. During a period of three months' summer working, the system being applied to a single retort-house, the average of the sulphur compounds in the gas was reduced to 26 grains. But there was disappointment when later in the year a second and larger retort-house was set to work,

and then the sulphur compounds jumped up from 26 to 36 grains. Why was this? Was it because there was a larger make and less time contact? and Was the liquor supplied to the hydraulic main in the winter months at a lower temperature than in the summer months? The article is interesting; and we hope that more will be heard of the subject—not only from Mr. Gill, but from others who may have tried similar experiments.

City and Guilds Examination Questions.

In last week's "JOURNAL," there appeared the questions in "Gas Engineering" framed by the Examiner, Mr. Thomas Glover, for the City and Guilds of London Institute examinations; and this week are published those set in "Gas Supply" by Mr. J. H. Brearley. With reference to the questions in "Gas Engineering," both in the Honours and the Ordinary Grades, they appeal to us as being extremely fair and comprehensive; and they entirely obviate two points of complaint that we have made in connection with examination questions in certain years in the past. There are no questions among those before us (there have been instances formerly) that can be said to be beyond the scope of any young fellow who has had a training on a gas-works, and who has, at the same time, kept himself (as he should keep himself) in line with the published information as to technical progress. Applying a critical eye to the questions from this point of view, in neither grade can they be termed "stiff"—as a matter of fact, there ought to be very few failures in the Ordinary Grade.

Practical Knowledge Requisite.

The other point upon which there has been complaint is that there have been occasions on which the questions have not been sufficiently comprehensive to ascertain whether the candidates have the all-round knowledge to justify the awarding of a certificate in "Gas Engineering." There have been times when it was quite easy for a gas-works chemist to pick out sufficient questions in his particular line, supplemented by the more simple ones in other directions, to gain for himself the necessary marks to obtain the 'Gas Engineering" certificate, though his knowledge of constructional work and drawings and of the mechanical plant may have been very superficial. The questions before us avoid the chance of this happening. It is right that the young fellow who receives a training as a gas engineer should have a good grounding in gas chemistry; but it is not right that a gas chemist, or a mere text-book student, who has not received a training in engineering and management, or who has not taken any steps to practically qualify himself in these directions, should be able to gain a certificate of equal face-value to the candidate of all-round practical training. As we say, we do not think it could happen on this occasion. The student to answer the questions, at all events in the Honours Grade, must have had a practical training as well as theoretical knowledge. The point is one that Mr. J. W. Helps stated, at the November meeting of the Society of British Gas Industries, was being considered by the Council of the Institution of Gas Engineers (see "JOURNAL," Nov. 29 last, p. 645). Admittedly there is a difficult problem here for any examiner; and we are sure that Mr. Glover will be pleased to give consideration to any suggestions from any source to make the examination test of knowledge of the utmost value.

The "Gas Supply" Questions.

The questions set by Mr. Brearley in the "Gas Supply" examination (published to-day) will be found about equally divided between practical knowledge of, on the one hand, gas transmission and measurement, and, on the other, of the application of gas to the various ordinary purposes. If there is a slight leaning at all, it is towards the latter. This applies to both the Ordinary and the Honours grades. Of course, it is impossible to cover in ten questions, with two or three alternative ones thrown in, the whole of the ramifications of matters affecting gas distribution and utilization; and this will account for the questions of high-pressure distribution, of higher and more uniform ordinary pressures, and the use of high-pressure gas in industrial operations being on this occasion left severely alone. But there are other important current questions touched upon—such as those of ventilation and internal atmospheric conditions. It is highly necessary for those who are engaged in the gas distribution and sales departments to be well primed in these particulars, in view of the malevolent slanders that are being assiduously and adroitly propagated by competitors. In the Honours Grade, we observe two or three questions over which we can imagine that not a few who are in the senior professional ranks, but who have no intention of presenting themselves as candidates for examination, would shy, and would require a little time for meditation and reference before attempting anything in the nature of a positive reply. Anyone who can answer directly from personal knowledge all the questions in the Honours Grade, it may be safely concluded is well cultured in gas distribution work.

Tar Specifications for Roads.

The general directions and specifications relating to the treatment by tar of roads that have been issued by the Road Board are of great importance to all producers of tar, who are looking for a developing outlet for this secondary product in this particular direction. The recommendations and specifications have been published in handy book form; and a copy should be in the possession of every gas undertaking. The production refers to tar surfacing and tar macadam and pitch-grouting work; and the Road Board hope that it will be useful to surveyors and others engaged in the work of road construction and maintenance. It is true the Board are only, in this matter, acting in an advisory office; but we cannot shut our eyes to the fact that their advice and recommendations will have considerable influence, and that influence will bear on the character of the tar purchasable for road purposes. We have only to bear in mind the recommendations for considerable grants that the Board have made, and will hereafter be making, for road improvement purposes in which tar will be used, to satisfy us that those road authorities who receive the grants will be anxious to conform to the suggestions of the Board. Furthermore, hitherto there has only been personal experience for guidance; and road surveyors will naturally incline to authoritative standard lines upon which to go. Those officials who accept the Road Board's suggestions will not henceforth look upon all that is designated "tar" as being tar suitable for their purposes. They will purchase under contract, the contract will define requirements in the matter of the important properties of the tar, and tests by an analytical chemist—in regard to specific gravity, freedom from water, fractionation, and free carbon—will ensure that what is bargained for is obtained.

Tar Direct from Gas-Works.

The specification as to the quality of the tar supplied direct from gas-works is not so stringent as the one quoted by Mr. H. C. Head in his Presidential Address to the Southern Association in March last. In that specification, it was provided that the tar should be free from admixture of tar derived from other sources than the carbonization of bituminous coal—in particular, of tar produced from carburetted water-gas plants. In the Road Board's specification, it is provided that the tar may contain 10 per cent. of its volume of tar produced in the manufacture of water-gas. The specific gravity recommended is the same, 1·19; but that is now the mean figure of the permissible range specified—1·16 to 1·22. Then, instead of stipulating that the tar shall not contain more than 0·2 per cent. of water or ammoniacal liquor, 1 per cent. is allowed; but the water or liquor is not to contain more free or combined ammonia than corresponds to more than 5 grains of ammonia per gallon of the tar (1 grain was mentioned in the specification quoted by Mr. Head). There is also a little relaxation in the next provision. In the specification referred to by Mr. Head, it was provided that "the tar shall not, on vigorous agitation for a quarter of an hour, with twelve times its volume of water at 70° Fahr., impart to the water more than 5 grains of phenoloid bodies reckoned as phenol (carbolic acid) per gallon of water." The "twelve times" is altered to "twenty times." The specification quoted by Mr. Head, we believe, was specially prepared for application in a district in which there are valuable fisheries. There is also a modification in regard to the amount of distillate (including water) between 170° and 270° C. Instead of "or less than 15 per cent.," it is provided that it shall "not be less than 16 per cent. or more than 26 per cent." But there has been a little tightening-up of the amount of free carbon. Instead of 17 per cent., it is not to exceed 16 per cent. by weight of the tar. Concerning this point, the low free carbon content of water-gas tar, and the allowance of up to 10 per cent. of that tar, will be helpful. Vertical-retort tar and heavy-charge tar from horizontal retorts will also stand a much better chance of compliance with

the free-carbon provision than tar from high-temperature, light-charge horizontalw orking. Anyway, the specification now before us, there is no doubt, will have to be largely faced, for the reasons advanced in the previous paragraph.

Liberal Use of Tar Advised.

There are one or two other interesting points about the issue of these specifications, which, after all, there can be no question, will influence considerably the extended use of tar for road purposes. At the end of each specification, there is a note to the effect that it "is not intended to displace or discourage the use of proprietary articles, of which there are several of proved value." But it is sufficient that the directions and the specifications throughout deal only with tar and pitch. It is also observed from the directions that the Board do not hold with any niggardly use of tar on roads. Road authorities, since they have been applying tar, have found that the cost of the work is soon repaid by the economies produced in road cleaning, watering, and repair. Of course, the quantity of tar required varies with the physical conditions of the roads. But the Board advise that, generally speaking, when a road is treated for the first time at least one gallon of tar should be used to coat from 5 to 7 superficial yards. Roads subject to heavy traffic should have their centres coated a second time two or three months after the first application, using a gallon of tar for every 8 to 10 yards super. On important roads the tar should thereafter be applied annually; and on roads subject to light traffic, the renewal should be as required. In tar macadam work, the quantity of tar needed is placed at approximately 9 to 12 gallons per ton of stone. Extracts from the specifications are given in another part of the "JOURNAL."

Daylight Saving Bill.

A large and enthusiastic meeting was held last Wednesday in the Guildhall in the City, under the presidency of the Lord Mayor, to further the chances of the Daylight Saving Bill becoming law. The principal speaker was Mr. Winston Churchill, M.P., who moved a resolution to the effect that the Bill "would conduce to the physical, mental, moral, and financial welfare of the nation." He said that in our latitudes our time-table was not applicable to the opposite seasons of the year. It was proposed to borrow an hour one night in April and to pay it back with golden interest five months later. It meant 154 hours more daylight, most of which would be hours of leisure. Sir Henry Norman, M.P., seconded the resolution, and said that, as the Deputy-Chairman of the Select Committee of the House of Commons on the Bill, he had listened to and considered all possible objections to the proposals. The most serious were the Stock Exchange and Continental Mail objections; but these could be surmounted. The Bill should be called a "Night-light Saving" one. An observation was overheard that the gas and electric lighting companies were opposed to the Bill; but it may be doubted whether the speaker had any foundation for such a statement. It is more than likely that, should such a Bill be passed, it would not make any material difference in lighting accounts; and, in any event, a great body of gas workers might share in the general benefits. Mr. Stanley Machin, the Chairman of the Council of the London Chamber of Commerce, spoke in support. Tributes were paid to the perseverance and "amazing energy" of the promoter, Mr. William Willett, who said that similar Bills had already been introduced in the Legislatures of Canada, Victoria, New Zealand, and Newfoundland. The figures given in the "JOURNAL" for Feb. 21 (p. 506), showing the support of various bodies to the proposals, were repeated at the meeting and indicated upon a large poster. As we then wrote, "Support spreads."

It may be remembered that early in the autumn of 1908 the ceremony was performed of laying the foundation stone of the engine-house at the Walton pumping-station of the Metropolitan Water Board. The station has now been completed, and it is to be formally opened by the President of the Local Government Board (the Right Hon. John Burns) on the 10th prox.

At the last meeting of the Mansfield Town Council. the salary of Mr. Arthur Graham, the Engineer and Manager of the gas and water undertakings of the Corporation, was, on a joint recommendation of the Gas and Water Committees, increased by £70 per annum from the 1st ult.. with an annual increment of £10 on April 1, 1913, and each succeeding year up to a maximum salary of £500 per annum, with an allowance of £35 per annum in addition for house rent and taxes.

PERSONAL.

Mr. T. S. CLAPHAM, of Messrs. Clapham Bros., Limited, the new President of the Keighley and District Chamber of Commerce, delivered his Inaugural Address at the meeting of the Council on the 28th ult. Mr. Clapham is Vice-Chairman of the Society of British Gas Industries, and is one of the representatives of the industry on the Advisory Committee in connection with the Livesey Chair at the Leeds University.

Mr. DUNCAN GRAHAM having been appointed Secretary of the Farnham Water Company, the position previously held by him in the Aldershot Gas, Water, and District Lighting Company, has been divided The vacancies thus caused have been filled by the appointment of Mr. C. T. GRAY, of the Ramsgate Gas and Water Department, as rental clerk, and Mr. W. H. SMEDLEY, chief clerk to the Langley Mill Gas Company, as gas and water collector.

At their last meeting the Directors of the Northampton Gaslight Company appointed Mr. GEORGE S. EUNSON as Engineer and Manager of the Company in place of his late father, Mr. John Eunson. Mr. George Eunson was born at Northampton in January, 1866; was educated at the Northampton Grammar School; and, after serving in his father's office, he went to the University of Edinburgh, and studied engineering under Professor Armstrong. Leaving there in 1888, he became assistant to his father; and has been at Northampton ever since. He has been associated with the late Mr. Eunson as Engineer of many smaller gas-works—for instance, those at Towcester, Weedon, Uppingham, and Welshpool.

OBITUARY.

The death occurred last Sunday, at "Scotlands," Farnham Common, in his 73rd year, of Mr. EDMUND BOULNOIS, formerly Chairman of the West Middlesex Water Company. He was twice Mayor of Marylebone, and succeeded Lord Charles Beresford as M.P. for East Marylebone in 1889, holding the seat until 1906. He was also a Magistrate for Middlesex.

Sir HENRY BEMROSE, head of the printing and publishing firm of Messrs. Bemrose and Sons, Limited, of Derby and London, died shortly before midnight on Thursday, at his residence, Lonsdale Hill, Derby, at the age of 83. He had been seriously ill with heart trouble for the past few months, and on Monday last week pneumonia supervened. During his long life he associated himself with almost every branch of public work in his native town of Derby. An old member of the Town Council, he served the office of Mayor in 1877-8, and again last year. He was a Director of the Derby Gas Company.

It is with the greatest regret that we have to announce the sudden death last Friday, at Broom Hill, Great Barr, of Mr. C. D. T. BUSHELL, J.P., who had been for nearly forty years the responsible Manager of the business carried on at West Bromwich as "Robinson Bros., Limited," tar and ammonia distillers. Mr. Bushell of late had been at times in indifferent health, but was able to attend to business up to the day before his death, and the end was quite unexpected. Mr. Bushell enjoyed the friendship and esteem of a large circle of friends in the Midland Counties, and his loss will be severely felt. The funeral took place yesterday (Monday) at the West Bromwich Cemetery.

The recent announcement of the death of Mr. ELLIS LEVER will remind many of our readers of an unpleasant, and happily rare, event in connection with the gas industry. After a lapse of nearly a quarter-of-a-century, it is scarcely worth while to recall the incidents of what was known as the "Salford Gas Scandal," except so far as they concern the gentleman who has just passed away. In September, 1886, Mr. Lever sent a telegram to the Mayor of Salford cautioning him against fixing the corporate seal to certain coal contracts. The despatch of the telegram resulted in an action for libel brought against Mr. Lever by Mr. Samuel Hunter, the Gas Engineer to the Corporation. It was tried at the Manchester Winter Assizes in 1887, and Mr. Lever was acquitted. A year later, Mr. Hunter was arrested on a charge of perjury and forgery in connection with the action, and was sentenced at the Central Criminal Court to five years' penal servitude, with a concurrent sentence of one year's imprisonment with hard labour on other charges. Mr. Lever was born at Kearsley, near Bolton, in October, 1833, and as a young man became a traveller for the sale of the then newly-invented wire ropes for collieries. Subsequently he commenced business on his own account at Gorton, Manchester, as a brattice cloth manufacturer. There he invented and introduced flexible air tubing for the ventilation of coal mines, together with other appliances intended to minimize the dangers of coal mining. He afterwards became a prominent figure in the gas coal trade, his business being carried on in Manchester; and he retired, about twenty years ago. In association with other Manchester men, he organized the Royal Jubilee Exhibition in that city in 1887. He had of late lived in retirement at Colwyn Bay, where he died on the 2nd inst. after a paralytic seizure.

The Spring General Meeting of the Midland Association of Gas Engineers and Managers will be held at Nottingham on Thursday of next week, the 18th inst., upon the invitation of Mr. J. H. Brown and the Gas Committee of the Nottingham Corporation.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 395.)

THE week just closed was not a particularly happy one on the Stock Exchange. The "bulls," who were the object of attack the week before, seemed to require a little more killing, and prices were freely knocked down against them. The position is somewhat artificial; and, with the monetary outlook and the general trend of events and circumstances, a rise rather than a fall might have been expected. Upon reopening on Tuesday, the markets were slow to get to work again; but the tone was favourable. Cheered by easy money, the gilt-edged division showed strength, and Consols rose ⅛ and ¼. Home Rails at once began to rise, but presently received a check, after which the advance was resumed. Americans were better, and Foreign firm. Business was not brisk on Wednesday. Rails began to give way, Americans were weak, and South Africans dull. Government issues were firm. Things were quite dull on Thursday. Consols receded, Rails were very weak as prices were dragged down by free selling, and most other departments were lower. Friday was rather better in tone, but business was not active. Rails, after a poor start, effected something of a rally, and a few issues closed higher. Government issues were dull, and Americans lower generally. Saturday was quiet and without change, though Consols were a little weaker. Rails were rather down at first, but picked up later on. The Money Market was well supplied, and a smart demand could not stiffen rates. Discount continued to ease-away steadily. In the Gas Market, there was more activity generally; and some issues were abnormally busy. The tendency was quite gratifying to holders; the strength which has now for many weeks characterized the market being enhanced by further advances in quotation. In Gaslight and Coke issues, the ordinary was more active and very steady; all transactions being within the old limits of 105½ to 106¼. Not much was done in the secured issues. The maximum realized 86½ and 86 free; and the preference 102⅜ and 103. South Metropolitan had about its usual average of dealings, and remained unchanged at from 119½ to 120½. In Commercials, the 4 per cent. only was dealt in; and it changed hands at from 115½ to 116. In the Suburban and Provincial group, Brighton and Hove original was done at 216, ditto ordinary at 158½ (a rise of 2), Brentford new at 202½ (a rise of 2½), Bromley "A" at 117, ditto "B" at 89, ditto "C" at 107, ditto debenture at 85½, North Middlesex at 14½, South Suburban at 120½, and Tottenham "B" at 116½. On the local Exchanges, Liverpool "A" marked 215 and 215½, ditto "B" 164, and Tynemouth 116—a rise of 1. In the Continental companies, Imperial realized from 191¼ to 192, ditto debenture 93 7/16 and 93½, Union 95¾, and European from 19¼ to 19 1/16. Among the undertakings of the remoter world, Bombay was done at from 6⅝ to 6 13/16, Buenos Ayres debenture at 97½, Primitiva at from 7 1/16 to 8 1/16 (a rise of ⅛), ditto preference at from 5 11/32 to 5 13/32, ditto debenture at 97½, San Paulo at from 15⅝ to 16⅛, and ditto preference at 11 1/16 and 11¾.

ELECTRICITY SUPPLY MEMORANDA.

Church Lighting—Drop in the Prices of High-Power Metallics—Causes and Professions—A Question of Lamp Efficiency—Practical Disadvantages of Electric Heating and Cooking—The Argument Value of the Electric Heater and Cooker.

THANKFUL is "Meteor" of the "Electrical Times" for small mercies. We can hardly imagine it, but it is perfectly true that he has been interested in certain reports of Easter Vestries at Canterbury. He finds with much gratitude that at St. Peter's "electric lighting had been a great success, and there had been a saving of £1 0s. 1d. (about half the gas bill) on the first quarter." "At St. Margaret's, the electric lighting is referred to most gratefully. At St. Paul's, there were more services than in 1909, and the electric bill is heavier, although we are not told how either year compares with the gloomy ages of gas consumption." That is all. But "Meteor" rejoices in these testimonials, so far as they go, to electric lighting. He has not, seemingly, inquired into the character of the gas lighting that previously obtained. It is also noted that at St. Paul's, the electric lighting bill is heavier, which is a common experience after users get tired of the exacting care that they take when electricity is first adopted. In regard to St. Peter's, it is observed that the past tense is used in conjunction with the "great success"—not the present; and, of course, the use of the future would have been out of the question. It is just possible that those concerned in St. Paul's, Canterbury, feel that a large amount of caution is necessary in speaking of electric lighting. It is possible, too, that they have seen the report of the Vestry meetings at Newport (Mon.). At one held at the Church of St. John-the-Baptist, the Vicar (the Rev. J. Frank Summers) was greatly impressed with the responsibility that rests upon him in connection with electric lighting and the safety of his flock. His pertinent remarks were reported in our news columns a fortnight since; but they deserve rather more prominence.

The reverend gentleman first referred to the extraordinary scene that occurred at St. Woolos Church on April 9, when, owing to the sudden failure of the electric light, the church was plunged into darkness. People stood up, women screamed with alarm, and some made for the doors. That is a pretty sort of thing to happen in a place of worship. When a serious panic appeared to be imminent, the voice of the Vicar (Rev. D. H. Griffiths), through the darkness, tried to reassure the congregation; and it was not until the emergency gas-burners were lighted up that the fears of the people were allayed. It was this occurrence that the Rev. Frank Summers was referring to when he stated at his own Vestry meeting that St. Woolos Church had been within an ace of an awkward and dangerous accident through the failure of the electric light. The reverend gentleman proceeded to allude to an occasion when the electric light failed them at St. John-the-Baptist; but then the congregation was not left absolutely in darkness owing to the lighted candles. His view was that something ought to be done to guard against this sort of thing; because, if there was a panic, it would be most awkward. Great as is the responsibility at any time in providing reliable lighting where people meet together, after warning the responsibility is greater. After considering the vicar's representations, it was decided to inquire of the Gas Company the cost of laying gas on to the church, and putting gas-burners over the doors and elsewhere. Public safety ever comes before cost. We cannot imagine that there is a vicar in the country who would ever forgive himself if there was a life lost or personal injury done through relying in his church upon a system of illumination of proved unreliability. It is singular that "Meteor's" interest in the proceedings at Easter Vestries should not have carried him to those at St. John-the-Baptist, Newport, Mon. Now that his attention has been called to the importance attaching to them, perhaps he will present the other side of the picture to his readers, and at the same time supply some information as to the character of the gas lighting that formerly existed in the churches referred to at Canterbury.

The high-power metallic filament lamps—those with three and four figures of candle power to their credit—have come down in price with a sudden rush and with common consent among the manufacturers; and the electrical papers are jubilant over the matter. But there is one thing that they desire to impress deeply upon all whom it may concern, and obviously upon the industry competing against metallic filaments with inverted burners. It is this (to use the words of one paper): "It should be clearly understood that there is nothing in the shape of a 'price war' in these reductions. They are the outcome of increased sales and the resulting economy in cost of production." Of course! It is represented that these high-power lamps up to 1000-candle power are having extraordinary sales. If this is so, the man in the street will wonder what manner of men these metallic filament lamp makers are who cannot wait for the sign of a little waning in the velocity of demand before cutting down their prices; and the man in the street will have a suspicion lurking in his mind that there are forces in operation other than increased sales and resulting economies of manufacture to account for the drop. But one has only to carefully read what has been written about the matter to see that cause and profession can only be brought into harmony by adding a little more of the former to the latter. One paper tells us that it is hoped by these reductions to largely increase the sale of these high-power lamps. This does not look as though the business is quite as luxuriant as it is attempted to make out.

Is another cause to be found in the difficulty the electricity supply industry is now experiencing with the inverted gas-lamp? Suspicious remarks are made by electrical papers. It is thought by one that the drop in prices will assist electricity supply authorities to better meet the competition of the inverted gas mantle. It is also learned that it will enable them the better to "wage war" against gas in street lighting. Another paper puts it that the cheapening will be of "great assistance to station engineers in their fight against gas for street lighting." But why does the electrical industry, through lower lamp prices, desire to be placed in a better position to wage war against gas, seeing that we also read "street lighting is a field in which the gas advocates fear the competition of the metallic filament lamp more than in any direction." Putting these various views together, the real secret of the reductions in price is plain. The inverted burner is making too great a headway in the streets and among shopkeepers to be pleasant for the electrical industry. The gas industry does not fear the metallic filament lamp in street lighting so much as it fears and resents unfair treatment in street lighting from the municipal owners of electricity supply undertakings. As to the influence that the drop will, it is supposed, have in encouraging tradesmen to adopt large metallic filament lamps, the "Electrician" cannot avoid what looks very much like an ill-favoured insinuation: "In this connection," it says, "the gas interests are specially active, and while we shall not discuss for the moment the methods which they adopt to persuade the tradesmen to fit gas lanterns or 'gas arcs,'" &c. We shall look with interest for the arrival of the moment when our contemporary will speak its mind frankly on the subject of the "methods" to which it refers; and we hope that ambiguity will then give place to something specific.

But as to the lower prices. In the case of the British Thomson-Houston Company, the prices of the "Mazda" lamps now stand as follows: 53-candle power, 4s. 6d. each; 90-candle power, 4s. 9d.; 180-candle power, 9s.; 270 and 360 candle power, 17s.; and 540-candle power, 20s. The General Electric Company announce that their 100-candle power lamps are now priced at 4s. 9d.; 200-candle power, 9s.; 400-candle power, 17s.; and 600-candle-power, 20s. Siemens Bros. have similarly priced their 200 and 400 candle power lamps. The Electrical Company announce

the following as their prices: 100-candle power, 100-135 volts, from 5s. 6d. to 4s. 6d.; 100-candle power, 200-260 volts, from 6s. to 4s. 6d.; 200-candle power, 100-260 volts, from 12s. 6d. to 9s.; 400-candle power, 100-260 volts, from 20s. to 17s.; 600-candle power, 100-260 volts, from 22s. 6d. to 20s. These are merely examples of what the other makers are doing. One of the fields in which high-power metallic filament lamps are having very much their own way is in the displacement of electric arc lamps, as, though they cannot boast the same efficiency, the trouble of "trimming" is avoided.

What is the wattage of these higher power incandescent electric lamps? No one seems to precisely know. Some of the makers are claiming an efficiency of 1 watt per candle; others a little above; one goes up to 1·35 watts per candle power. Others prefer to describe their lamps by the consumption rather than the candle power. In this perhaps they are wise, though we prefer to know what lighting power is claimed for an electric lamp for a given consumption. Taking consumption alone in the case of an electric lamp is not a satisfactory way of stating its capability. For instance, what is the lay user to make out of a lamp that comes to him merely as a 200 watt or a 400 watt lamp? True he is able to check the consumption to see whether the lamp's performance in this respect is in accordance with the declared figure. But though we like to know what is the asserted efficiency, there has been little honesty exhibited in the matter of the nominal candle-power distinctions placed upon electric lamps. How many arc lamps in actual running give anything like the light ascribed to them by the candle-power appellation under which they are sold? We may in time find out, as has been ascertained with the lower units, that the efficiency of the higher power metallic filaments is not so close to the 1 watt per candle as is claimed. In the case of the lower units, the National Physical Laboratory, Mr. Haydn Harrison, and others have shown that, to assert that the lamps have an efficiency of 1 watt per candle, is untrue. It is more like 1·3 to 1·4 watts. There has also been protest against describing Hefner units as British candles. Time will no doubt give us the proper efficiencies of the high-power metallics.

Imagination has played a large part in electrical writing on the subject of cooking and heating; and those in the long ranks of electricians who have indulged in this have looked upon it not from the moral standpoint, but as one of the (to the bulk of electricians) few permissible joys of life to think of and picture the reverse of existing fortune. Occasionally, there are electrical writers who will go part of the way along the road of truth and actuality when treating of the particular subject before us. There is the leader writer in "Electrical Industries." He was dealing with the question of efficiency the other day, in connection with Professor Fleming's Cantor Lecture suggesting that electric kettles should be tested for efficiency in the presence of the buyer. The writer in our contemporary does not take the learned but (in this matter) unpractical Professor very seriously in this connection—in fact, the very little attention that has been paid by our electrical contemporaries generally to the Professor's lectures suggests that they agree with us that he was in some respects a bit up in the clouds over certain of his statements, while the electrical industry has to-day to give very close consideration to things from the mundane point of view. Well our friend of "Electrical Industries" does not think much of the electrical test in the presence of a householder whose patronage is desired. There is prudence in this. But he sees no objection to giving the public a guarantee of efficiency with electric kettles and other appliances, much as is done "in some cases" with electric lamps. It is perfectly easy to agree with him that "it is possible to make too much of efficiency under test in the workshop or the laboratory. Efficiency may be a very vital point; but it is by no means everything to the user of electric cooking and heating apparatus." Even Professor Fleming might proceed with his investigations in a chastened spirit if he read these profound utterances.

But there comes a point upon which we question the competence of the writer of the article to express any opinion. He asserts that "if the claims of gas-cooking apparatus had been based wholly or primarily upon efficiency in the production of heat from fuel, little progress in cooking and heating would have been made by gas undertakings. Such apparatus has made headway because of its superior convenience; it is used in spite of its wastefulness and unhealthiness." We should be greatly obliged to the writer of these words if he would just detach himself from ambiguity and electrical platitudes, and tell us, in more precise terms, something about this supposed inefficiency and unhealthiness of the gas-cooker. Then we find that "electric cooking and heating apparatus makes its appeal on the grounds of still greater convenience, allied with perfect healthiness and cleanliness." We have just been reading about the "superior" convenience of the gas-stove; and now we find that electrical apparatus has a "still greater" convenience than the "superior" convenience of the gas-stove. This is rather confusing; and confusion grows as the reader proceeds. How, for example, can electric heating and cooking apparatus be a still greater convenience when it has "serious practical disadvantages." We do not know whether the writer of the article now before us has had an electrical cooker in use to gain experience as to its economy and cleanliness; but, if not, it would be worth while for him to try one. However he appears to perfectly understand another aspect of the use of these unsatisfactory appliances, for he says:

> No high figure of efficiency can make up for lack of reliability and of capacity to stand wear and tear. In spite of the improvements which have been made in methods of construction, there is a good deal of the electric cooking apparatus on the market which is not suited to the rough-and-tumble of ordinary treatment in the kitchen. Electrically it may be admirable, but mechanically it is deficient. And the reason is that the makers have concentrated their attention on efficiency tests, and not subjected the apparatus to the only really useful test—that of six months' hard labour with a heavy-handed cook.

Does the writer mean to insinuate that the makers of such appliances do not, as is the case with those wise electrical engineers with whom we occasionally come in contact, use them in their own kitchens? Surely they do; and, if so, they must know what a heavy-handed cook can do with them.

After all this, we need not pay much attention to the writer of some notes in another electrical paper, who says that gas companies "seem" already to be feeling the draught from the "growing" competition of electric heating and cooking. This weighty opinion is founded upon two pretty little stories that "seem" just about suitable for the nursery. Once upon a time, a lady who used the electric light became dissatisfied with her gas cooker and with a gas-fire in one of the bedrooms. Both appliances were on hire. Complaint to the gas company brought upon the scene a representative, who appeared disinclined to replace either or both without payment—the existing apparatus being comparatively new. Then the lady threatened this wicked, obstinate wretch of a gas man that she would instal an electric radiator and an electric cooker. She knew better than to do it. But any way the gas man collapsed, and promptly supplied the new appliances. Then, also once upon a time, there was a young married couple who rented a floor in a large house, and had it wired for the electric light. The gas-pipe in the room to be used as a kitchen was not large enough to supply a cooker, and in any case it could not be utilized without a sub-meter, since the gas consumed would be registered on the meter belonging to the other occupants of the house. A new main involving a long run was therefore necessary; but the gas company said they would not put this in without payment, nor were they inclined to supply the patterns of cooker and fire selected by the tenant. Then the argument value of the electric cooker was again proved. The gas man was menaced with the electric cooker; the gas man forthwith collapsed. The main, so runs the tale, went in free of cost; and the fancied type of cooker and fire also went in. The reciter of these little narratives winds up by saying that formerly such concessions would never have been wrung from the gas company. Now he must not fall into the error of supposing that all gas companies are the same in their business methods; nor must he fall into the error of thinking that his stories show all the reasonableness to be on one side, and all the unreasonableness on the other. In the first instance, "the existing apparatus was comparatively new;" in the second case, "a new main involving a long run had to be installed." But the stories are strong against electric cookers and heaters; for they both show how persistent was the preference for gas cookers and fires in both dwellings.

Gas v. Electricity for Heating Purposes.

It is not every day that the general public has an opportunity of witnessing a practical demonstration of "Gas *v.* Electricity" applied for heating purposes. A few days ago in one of the leading thoroughfares of Warrington, a gang of men employed by the Corporation Electric Light Department was seen trying to fuse a hole through the side of a box made of manganese steel, by means of electricity. After many hours' laborious work without tangible results, a workman passing by suggested that they should apply to Messrs. Fletcher, Russell, and Co., for a blowpipe of their manufacture, which would easily do the work. Needless to say, his advice was quickly acted upon; and in a short time a workman employed by the firm was on the scene with the blowpipe and a cylinder of oxygen. A supply of coal gas was taken, by means of a length of flexible piping, from premises close by; and in a few minutes the troubles of the Electrical Engineer were at an end. It is satisfactory to learn that the firm were rewarded with an order from the Corporation for the blowpipe that had been used.

The Projected Smoke Abatement Exhibition in Manchester.—In the article on "The Smoke Abatement Campaign in Manchester" which appeared in the "JOURNAL" last week (p. 318), it was mentioned that an Advisory Committee had been appointed to take the initiative in connection with the holding of a Smoke Abatement Exhibition in Manchester next November, under the auspices of the recently-formed Manchester and District Smoke Abatement Society. We learn from the Hon. Secretary (Mr. James Kendall, J.P.) that the Committee is composed of the technical heads of the Manchester and Salford Gas, Electricity, and Sanitary Departments, with whom are associated several professional gentlemen whose services will help considerably towards bringing the object of the exhibition to an assured success. Among the patrons of the exhibition are Mr. Thomas Newbigging, Mr. Dugald Clerk, and the following gas engineers: Messrs. J. H. Brearley, Crowther, Duxbury, Kendrick, Prince, and Whatmough. Satisfactory arrangements have been made with Mr. Walter Cawood, of the City Exhibition Hall, Manchester, to undertake the management of the exhibition on behalf of the Society.

NOTES FROM WESTMINSTER.

For gas people this is a dull and dreary session. There has been nothing much in the way of interest to pick up; and there will certainly not be much now. The Swansea Gas Company's Bill and the Greater London Railway Bill may, however, provide something worth looking at. The Swansea Gas Bill is in a group that will start before a Committee of the House of Lords to-day. But the Company and the Corporation have been negotiating; and hope is not altogether dead that there will be an eleventh hour reconciliation even now, though the Corporation have put on their armour ready for the fray. Regarding the Greater London Railway Bill (which is before a Commons Committee, over which Sir J. Compton Rickett is presiding), it is being strongly supported by public authorities, such as the Port of London and the War Office; but the great Railway Companies are dead against it. So are the Brentford Gas Company, as the promoters propose to cut right through their Southall works, which are the ones that have been under development for years past with an eye both to present and prospective requirements. In connection with water schemes, there has been a copious flow of evidence before Committees of both Houses since the Easter recess.

Gas Supply and a New Bridge.

Since the last budget of "Notes" from the Committee rooms, there has been, as intimated above, little indeed that interests in the gas line; but the few points may be indicated, in order to maintain the continuity of record. The City Corporation are in Parliament in connection with their scheme for further improving the bridging of the Thames, in order to relieve, by diverting the traffic, the congestion that now takes place in the streets of the City. The proposal as to a new bridge, known as the St. Paul's Bridge scheme, is the latest; and there appears to have been some idea on the part of the Corporation as to shutting out the Gaslight and Coke Company and the South Metropolitan Gas Company from securing in connection with it the ordinary rights. However, a little discussion of the matter, in which Mr. Balfour Browne, K.C., took a prominent part, has brought the Corporation to a more friendly frame of mind; and they have agreed to the Companies having reasonable accommodation on payment of a reasonable annual wayleave. The South Metropolitan Gas Company also sought to obtain compensation for loss of revenue occasioned by the disturbance of consumers by the construction of the new bridge; but the claim has been disallowed.

A County Council's Opposition.

The Enfield Gas Company's Bill has been through the House of Lords; and it has since been before the Court of Referees preparatory to coming before a Select Committee of the Commons. The Middlesex County Council sought to obtain the right to an unrestricted *locus*, in order that they might attack the Company from all quarters. It will be remembered that the Council were smote hip and thigh over their unconscionable attitude towards the Company in the House of Lords, when they tried to get them tied up to all sorts of very onerous stipulations as to pipe depths and costs of alterations in respect of their distribution system. Now the County Council have come forward seeking to take upon themselves lines of opposition that the local authorities see no reason whatever to take up. The County Council proposed to offer an all-round objection to further capital powers being granted to the Company; they also intended to resent the "alteration of the position" between the Company and their consumers; and they asked for further protection in regard to the breaking up of streets, and to the exercise by the Company of other powers under existing Acts. The Court of Referees were curious as to why the County Council were desirous of raising opposition on so many points while the local authorities and the consumers were quiescent and content. Learned Counsel for the County Council shrugged his shoulders, and submitted that most of the local authorities had Electric Lighting Orders; and therefore they have no interest in seeing that gas consumers are looked after. This Counsel has much to learn. He cannot have kept a very close watch upon the bitter hostility that has so frequently been displayed towards successful gas concerns since local authorities became electricity suppliers. As to why the Council should interfere between the Company and their consumers, they submitted that they themselves, as the educational authority, are large consumers. They are gas consumers in the aggregate of a fraction of 1 per cent. of the Company's output! The other ninety and nine per cent. saw no reason for opposition. The Court of Referees practically told the Council on these points to mind their own business; and they would only give them the right to appear on the clause in the Bill dealing with pipe laying for, principally, ancilliary purposes. The Middlesex Council are certainly not coming out with flying colours in their contest with the Enfield Company.

Unopposed Bills.

The Chesham and District Gas Company's Bill has passed before the Unopposed Bills Committee. In the interests of peace, the additional capital has been reduced to £20,000. There have been amendments in regard to price; but the permissive power to charge a maximum of 1s. extra for gas supplied in out-districts has been allowed to stand. The Chasetown Gas Bill was before the same Committee. It is a very small affair, but interesting. The whole district of this little concern was really in the statutory area of the Lichfield Gas Company, who obtained their Act in 1878—eight years after the existence of the Chasetown Company began. Now that the latter are in Parliament for an Act, among other things for defining their area, the Lichfield Company slipped in; and it was thought prudent to agree upon an area for the Chasetown Company somewhat less in extent than contemplated in the Bill. As a result, the capital proposed by the promoters has been reduced to £12,450. The question has been raised as to why the Company did not proceed by way of Provisional Order, instead of by Act. The short answer is that the Board of Trade cannot repeal rights conferred by statute; and the Lichfield Company had certain territorial rights under their Act which the Chasetown Company were seeking to end.

Metropolitan Water Supply.

The Bill promoted by the Metropolitan Water Board is going to have an abortive result. As interested readers are aware, the scheme was an extensive one for constructing new reservoirs in the Thames Valley. It aroused tremendous opposition; and it was decided to refer the measure, with one promoted by the Thames Conservancy Board, to a Joint Committee of both Houses. There is one thing very certain that London must look forward in the matter of water supply; and the future must be provided for in the most economical manner. It may be relied upon that the Engineer of the Board (Mr. W. B. Bryan) laid the lines of the scheme with this in view. But during the hearing of the evidence, the Committee so dismembered the project that the Board have determined not to proceed with it further this session. Under these circumstances, we need not in the "Notes" traverse the evidence the Committee have heard. Certainly the Board's difficulties are not being lightened by their experiences in Parliament this session. Another matter of anxiety for them has arisen over the Conservancy Bill, in which the Committee have decided to insert conditions limiting the right of the Board to take water from the Thames. The Board have, however, intimated that they are not prepared to surrender, on the terms indicated by the Committee, their unrestricted right to abstract 130 million gallons of water per day from the river.

[A number of points have arisen in connection with other Water Bills; and we will review them in subsequent "Notes."]

SOCIÉTÉ TECHNIQUE DU GAZ.

Programme of Annual Meeting.

A rather formidable-looking list of thirty-four reports, papers, and discussions constitutes the technical programme at the annual meeting of the Société Technique du Gaz, which (as already announced) opens on Monday, the 22nd inst., at Marseilles. There will be presented five reports from the different Committees of the Society, the organization and object of which we gave in the "Journal" of Feb. 7, p. 382.

These Commissions or Committees deal in their reports respectively with general instruction, analysis of coal, manufacture, distribution, and application of gas. Two papers describe retort-furnaces—one by M. Stein, on a regenerative setting without chamber; the other by M. Defoy, on a regenerator described as being "wholly accessible" for examination purposes. A machine with divided scoop for charging retorts will be explained by M. Visinet. Apparently no paper is offered on the subject of gas purification; but M. Laurain deals with tar condensation, M. Grebel with direct absorption of ammonia, while M. Chevalet will bring to notice an ammoniacal liquor meter. The variations in the volume of gas given off during carbonization form the subjeet of a note by M. Defoy. The Hamburg gasholder accident will be mentioned by M. Bonnet; and there will be both a special discussion and a paper on the contamination of gas in holders. A further discussion will have as its topic methods of manufacture in small works carbonizing from 3000 to 10,000 tons of coal per annum. M. Heede will advocate the use of dust and tar for gas-works' paving. Two papers refer to water gas—one by M. Des Gouttes, on the plant at the Geneva Gas-Works; the other by M. Delahaye, dealing generally with the subject. Then we come to a group of seven or eight papers, describing various methods of automatic lighting; M. Sost referring to a safety apparatus for automatically cutting off gas-mains. One or two other communications deal with particular burners for incandescent lighting; and M. Bertin describes a new gas-heated boiler for warming premises by hot water.

The division of the work of the Congress is arranged upon the now familiar lines of the Society. The morning of the first day is taken up by the business part of the meeting; while in the afternoon are the President's (M. Marquisan's) address and the distribution of awards. At night, there will be the dinner offered to the Society by the Marseilles Gas and Electricity Company. Visits will, of course, be paid to the local gas-works and to other places of interest; and the excursion on Thursday, the 25th inst., to Hyères will bring the annual gathering to a close.

Mr. John Giles Pilcher, J.P., D.L., of Bellefields, Englefield Green, Surrey, also of Stockwell and Brighton, a Director of the Commercial Gas Company, who, as already recorded in the "Journal," died on March 17, aged 85, left estate valued at £202,721 gross, of which £179,801 is net personalty.

GERMAN GAS AND WATER ASSOCIATION.

Annual General Meeting.

It has already been announced in the "Journal" that the fifty-second annual general meeting of this Association will be held at Dresden from Monday, the 26th, to Friday, the 30th of June. The provisional programme of the arrangements for the meeting has now been issued.

The Municipal Council of Dresden will hold a reception of those attending the meeting, in the Rathaus, on the evening of Monday, the 26th prox. The mornings of the three following days will be devoted to the technical proceedings of the meeting—gas papers being taken on the first of these days, water papers on the second, and the reports of Committees and private business on the third. The list of papers and reports which will be presented is given below. On the afternoon of Tuesday, the 27th prox., one group of members will visit the Dresden Corporation Gas-Works at Reick, and another group the irrigation works in the suburb of Kaditz. In the evening, there will be an assembly in the palace of the Hygiene Exhibition. On the Wednesday afternoon, one group will visit the Meurer Iron-Works at Cossebaude and thence go by steamboat to Meissen, where the evening will be spent and the return journey to Dresden made by special train. Another group will visit the Dresden Corporation Water-Works, at Hosterwitz, and from Pillnitz (near by) will make a steamboat excursion up the Elbe to Königstein. The banks of the river will be illuminated for the return journey. On the evening of Thursday the 29th prox., there will be a dinner in the banqueting hall of the Hygiene Exhibition; and Friday, the 30th, will be devoted to visits of inspection to the exhibition. A special programme is arranged for lady guests during the mornings when the technical proceedings are in progress.

The latter proceedings will take place in the lecture hall of the Hygiene Exhibition, under the chairmanship of Herr Prenger, the Manager of the Cologne Corporation Gas, Water, and Electricity Works, the President of the Association. He will open the proceedings with an address, in which he will review the position of the gas and water industries. The following papers will then be read and discussed: "Some Observations on Gas Coke, from the Standpoints of the Commercial Man, the Accountant, and the Gas Engineer," by Mr. E. Körting, of Berlin. "New Methods of Quenching Coke," by Herr F. Göhrum, Manager of the Stuttgart Gas-Works. "Long-Distance Gas Distribution; its Application and Economy," by Herr E. Blum, of Berlin. "The Work of the Instructional and Experimental Gas-Works of the Association," by Dr. H. Bunte, Professor at the Technical College at Carlsruhe. "Recent Pumping Machinery for Water-Works," by Herr R. Schröder, of Hamburg. "The Activity of the Association in Water Supply and Sewage Disposal," by Herr Herzberg, of Berlin. "The Production of Artificial Underground Water from River Water," by Herr Fr. Scheelhaase, of Frankfort-on-the-Maine. "The Action of Ultra-Violet Light on Water," by Professor Courmont, of Lyons, and Professor Bujwid, of Cracow. "Experiences in Long-Distance Igniting Equipment," by Herr H. Metzger, of Bromberg, and Herr E. Kobbert, Manager of the Königsberg Gas-Works. "The Use of Tar in Diesel Engines," by Dr. Allner, of Dessau. "Novelties in Consumers' Gas Apparatus," author not stated.

The reports of the Technical Committees appointed by the Association to deal with the subjects named will be presented by the respective Chairmen—viz., on "The Working of Water-Works," by Herr F. Reese, of Dortmund. "Electrolysis," by Sir W. H. Lindley, of Frankfort-on-the-Maine. "The Instructional and Experimental Gas-Works of the Association," by Dr. K. Bunte, of Carlsruhe. "Photometry," by Dr. Leybold, of Hamburg. "Heating," by Dr. E. Schilling, of Munich. "Gas-Meters," by Herr C. Kohn, of Frankfort-on-the-Maine. "Gasholder Standardization," by Herr Niemann, of Dessau. "Standardization," by Sir William H. Lindley, of Frankfort-on-the-Maine. "Technical Training," by Dr. W. von Oechelhaeuser, of Dessau. "The Working of Gas-Works," by the President, Herr Prenger.

The private business to be transacted will include the presentation of the annual report of the Association, that of the Schiele Foundation, and that of the Benevolent Fund, and the making of grants, and the election of President and Members of Council for the ensuing year. Dresden has been selected as the *venue* for this year's meeting on account of the attraction of the Exhibition of Hygiene, which, covering an area of some 80 acres there, was formally opened on Saturday last.

Society of British Gas Industries.—We have received a copy of the rules and a list of members of this Society for the present year. The President is Professor Arthur Smithells, F.R.S., whose predecessors were Mr. Balfour Browne, K.C., Mr. Thomas Newbigging, the late Sir George Livesey, and Mr. Dugald Clerk, F.R.S. The Chairman of the Central Council is Mr. H. J. Yates; the Vice-Chairman, Mr. Thomas S. Clapham; and there is a goodly list of Chairmen of the various sections of the Society. The members, of whom there are close upon a hundred, represent every branch of the gas industry. The Hon. Secretary is Mr. Charles Clare; and the Secretary, Mr. Arthur L. Griffith, whose office is at No. 46, Queen Victoria Street, E.C.

ASSOCIATION OF SWISS GAS-WORKS.

Appointment of Technical Inspector and Permanent Secretary.

The "Journal für Gasbeleuchtung" reports that, at a special meeting of the Swiss Association of Gas and Water Engineers, held at Olten on the 8th ult., under the chairmanship of Herr Weiss, Manager of the Zürich Gas-Works, it was unanimously decided to establish a technical inspectorate for Swiss gas-works, and to appoint a Permanent Secretary of the Association. In order not to make the financial burden too great, it was agreed that these offices should at first be associated with the existing coal coalition of Swiss gas-works. The technical inspector will be charged with the duty of seeing that the regulations issued by the Association for securing safety in construction and working of gas-works are observed, as well as with the revision of plans for new work, and periodical inspection of the gas-works, the investigation of the causes of breakdowns and accidents, and the collection of statistics and issue of an annual report. Of the 78 gas-works in Switzerland, 50, including all the larger works, have already agreed to adopt the inspectorate; and the remaining small works are expected to fall in with the scheme. Herr C. Roth, who has since 1899 been Manager of the gas and water undertakings of Berne, and is President of the coal coalition of Swiss gas-works, was appointed first Inspector and Permanent Secretary under the new scheme, which is to come into operation on the 1st of September next, with headquarters at Zürich.

COAL GAS SUPPLY IN RUSSIA.

[From a Correspondent.]

In the course of an exhaustive article on the economic and commercial undertakings of Russian towns in relation to municipal budgets, particulars are given of the gas concerns throughout Russia. According to the statement of the Central Statistical Committee, gas lighting exists in Russia in 33 towns only out of a total of 1084. But there are statistics available from other sources of later date, which put the number of towns lighted by gas at 36, making 3·3 per cent. Of these towns, only 14 are capitals of provinces. It must be observed, in connection with this statement, that the application of gas is most marked in the Privislinsk district, and the Baltic district, in which latter it has been used in five towns—in Riga since 1861; in Reval, Libau, and Yurieff since 1880; and also in Polangen, respecting which the date of installation is not given. In the Caucasus, gas lighting is used in three Government towns—Pyatigorsk, Armavir, and Anapa. In Asiatic Russia, there is not a single town lighted by gas; and in the rest of European Russia, there are seven Government towns and twelve others so illuminated.

The concession system of exploiting prevails in Russia in respect to gas lighting. According to informatiou received as the result of a special inquiry published in the Government "Financial Gazette," the exploitation of gas factories by municipalities exists only in Riga, Reval, Vladislavoff, and in the towns of Moscow and St. Petersburg, where the gas concerns were bought by the Municipalities in 1905 and 1908 respectively, and to which must now be added Odessa, which bought back its gas-works in 1909. At the present moment, at Wilna, alongside the existing private gas-works, town gas-works are being built. The Yurieff Gas-Works it appears were built in 1880 on the initiative of the town. The Reval Gas-Works in the year 1907 yielded 96,100 roubles revenue, against an expenditure of 94,400 roubles—that is to say, expenditure and receipts practically balanced. The cost of the enterprise was 235,500 roubles. The Yurieff Gas-Works yielded 18,100 roubles net; and they cost 310,300 roubles. In Odessa, the estimated receipts from the gas concerns are put at 473,900 roubles, and the expenditure at 368,700 roubles; the net estimated profit being 105,200 roubles.

But in the capital cities of the country—Moscow and St. Petersburg—much larger figures are dealt in. The Moscow Gas-Works during recent years have yielded the following financial results, in roubles:—

Years.	Gross Receipts.	Expenditure.	Profits.
1908	1,513,200	1,362,200	151,000 = 10·0 per cent.
1909	1,575,000	1,452,200	122,800 = 7·8 ,,
*1910	1,552,100	1,347,800	204,300 = 13·2 ,,
*1911	1,749,800	1,468,800	281,000 = 16·1 ,,

* Figures for these years are estimated.

The receipts of the gas enterprise in Moscow have been growing recently, thanks to the considerable increase in the private consumption of gas. This for the last few years has been as follows: 1906, 200,900,000 cubic feet; 1907, 214,300,800 cubic feet; 1908, 218,500,000 cubic feet; and 1909, 237,400,000 cubic feet. The estimate is not given for 1910; but the 1911 consumption is expected to reach 297 millions. There is particularly to be noted a large increase in the consumption of gas in Moscow for heating. For this purpose gas is sold at a discount; and it was delivered as follows: 1906, 30,200,000 cubic feet; 1907, 38,800,000 cubic feet; 1908, 43,000,000 cubic feet; and 1909, 61,400,000 cubic feet. Again, 1910 is omitted from the statement; but 1911 is expected to show a consumption of about 110,000,000 cubic feet of gas for heating purposes.

The St. Petersburg Gas-Works, since the time of their transfer

into the hands of the city, have yielded the following financial results in working (the figures being roubles):—

Years.	Gross Receipts.	Expenditure.	Profits.
From 10-23 Oct., 1908, to 10-23 Oct., 1909 . .	1,518,300 ..	1,136,000 ..	382,300 = 25·2 p. ct.
From 1-14 Jan., 1909, to 1-14 Jan., 1910 . .	1,523,400 ..	1,124,900 ..	398,500 = 26·2 ,,
1910 (estimated).	1,391,700 ..	1,132,200 ..	259,500 = 18·6 ,,
1911 ,, .	1,386,600 ..	1,098,000 ..	288,600 = 20·8 ,,

The private consumption of gas in St. Petersburg in 1905-6 almost doubled that which obtained in Moscow; while with the growth of such consumption in Moscow there is observed in St. Petersburg a considerable reduction. In 1905-6, the make was 344,500,000 cubic feet; in 1906-7 it was only 327,800,000 cubic feet; in 1907-8 340,700,000 cubic feet; in 1909, 305,900,000 cubic feet; from 1st/14th May, 1909, to 1st/14th May, 1910, 299,600,000 cubic feet; and a further reduction to 295,500,000 cubic feet is expected for the 1911 working year—that is to say, even less than in Moscow. Besides this, the consumption of gas for the illumination of the streets of St. Petersburg was originally larger than in Moscow. St Petersburg proposes to spend more for this purpose in the current year—viz., 163,700,000 cubic feet against Moscow's 112,100,000 cubic feet. In both towns there is observed a gradual rise in the consumption of gas for street lighting. In Odessa, the total consumption of gas in 1910 amounted to about 160 million cubic feet.

The price of gas per 1000 cubic feet for private consumption in St. Petersburg was 2 roubles 44 copecks* in 1905-6, 2 r. 36 c. in 1906-8, and 2 r. 57 c. in 1909-11. In Moscow, the rates for 1909-10 were 3 r. 5 c. It is proposed to reduce it to 2 r. 80 c. for the present year. In Odessa, the price was fixed at 3 r. in 1910. For street illumination, Moscow calculates 1 r. 70 c. per 1000 cubic feet; St. Petersburg, 1 r. 60 c.; Odessa, 1 r. 10 c.

Thus up till the present, St. Petersburg, which is supplying gas at a lower price than Moscow, is making a larger profit. It is not difficult to observe, however, from the figures given, that this situation will be reversed in the near future. This is all the more probable from the fact that Moscow is at present engaged in a large extension of its gas-works, and has been very successful in increasing the number of consumers of gas for heaters, cookers, and baths, which in St. Petersburg has hardly yet been attempted. On the other hand, in the St. Petersburg town government considerable attention has been given to the re-organization of the gas business. A detailed plan has already been elaborated for the exploitation of the gas-works over the next fifty years; and it will shortly be submitted for the approval of the Town Council. In St. Petersburg, however, the principal question—whether the gas-works shall remain in the possession of the town or be the subject of a concession—has not yet been decided. If it is decided to construct new works with a productive capacity up to 2000 million cubic feet, as the Town Revision Committee propose, a loan will have to be negotiated which in the first instance will come to 5,080,000 roubles. If land has to be purchased for the construction of the works, the amount will be 7,090,000 roubles in the first instance, and in the three succeeding stages of the development of the work (which is divided into four stages) 6,960,000 roubles, or a total of 12,000,000 to 14,000,000 roubles altogether. In the city of Odessa, it is considered almost settled that the gas undertaking will be handed over to a new concessionnaire. It is intended to spend a sum of upwards of 2,000,000 roubles for extending the works.

* One rouble equals 2s. 1½d., and one copeck ¼d.

Sheffield University Gas Students' Association.

On Saturday, past and present students in "Gas Engineering" at the Sheffield University entertained Mr. J. W. Lee, the lecturer in this subject, to dinner at the Grand Hotel. Mr. E. M. Myers was in the chair; and a short toast list was gone through. In proposing the health of "Our Guest," the Chairman referred to the very able and efficient manner in which Mr. Lee had always conducted his lectures, and also to the kindly way in which he treated every individual student. Mr. Lee was thoroughly assured of the high esteem in which he was held by all present. During the evening, an informal meeting was held, at which it was decided to form a Society, to be known as the "Sheffield University Gas Students' Association," to be open to past and present students of the Applied Chemistry Department. Mr. Lee was chosen first President and Mr. Myers as Secretary.

International Road Congress in 1913.—Arrangements are being made, and the British Government has issued invitations, for an International Road Congress to be held in London in 1913. Sir George Gibb, Chairman of the Roads Board, presided last week over representatives of about 50 Associations concerned in the questions involved. The rapidly developing methods of mechanical traction upon the roads of our country raised new interests, new needs, and likewise new burdens; and we may add that the gas industry may possibly have to bear some portion of the last. An Executive Committee has been appointed to make the necessary arrangements.

THE EXTRACTION OF SULPHUR COMPOUNDS.

By G. M. Gill.

The decision of the Coventry Corporation to revert to lime purification, on the advice of Dr. Colman, raises an interest in this question which a few years ago many had hoped was destined to die a natural death. Everyone is agreed that lime purification not only increases the cost of gas, but is also universally considered as a public nuisance in any neighbourhood. It is, therefore, to be avoided if possible. But when the quantity of sulphur compounds in gas much exceeds an average of 35 grains, it becomes a choice of two evils. The remedy, however, must not be worse than the disease. From Dr. Colman's report, it would appear that he considers an average of 35 grains as satisfactory—an opinion from which there will be few dissentients. Unfortunately, some coals contain much sulphur; and in cases—such as Coventry, where special reasons exist for using such coal—this question has to be considered. The time is therefore ripe for discussing the removal of this sulphur impurity by methods not open to the serious objections always connected with lime purification.

Sulphur Question in 1870.

In the year 1870, the Gas Referees published a report on the sulphur question. In the course of this, it was shown that at the time the method of its removal was not understood. Lime was in use in many works; but the formation of the sulphide material for the removal of carbon bisulphide was not discovered until later. Consequently, there was a great deal of variation in the results shown by the use of lime. In some works, where the sulphide material was accidentally formed, much of the carbon bisulphide was removed; but there was nevertheless a good deal of fluctuation in the results, owing to the destructive effects (not then recognized) of allowing the carbonic acid in the gas to pass into the "sulphide" purifiers.

Proposed Method of Liquor Purification.

By 1875, the formation of the sulphide material was understood, and Patterson proposed that alkaline sulphides in solution should be formed in a suitable vessel by passing in gas previously freed from carbonic acid, owing to the fact that it had been discovered that carbonic acid was capable of decomposing the various alkaline sulphides with the formation of carbonate and the expulsion of sulphuretted hydrogen. He recommended the then modern type of washer as better adapted for his method of treatment than any form of scrubber, and pointed out that by the ordinary way of using these vessels they are quite useless in removing the bisulphide of carbon. In fact, it was found that the amount of "sulphur" at the outlet often exceeded that found in the inlet.

It was known that CS_2, although a chemical neutral, acted in some cases like an acidulous body, and was capable of combining with the alkaline sulphides to form sulphocarbonates. These compounds are formed by the direct union of single equivalents of the bisulphide with an alkaline sulphide; and it is undoubtedly due to the formation of these combinations that sulphides of calcium, sodium, and ammonium are found so efficacious in dealing with the sulphur impurity in coal gas.

In Patterson's system, advantage was taken of the superior affinity of the alkalies generally for carbonic acid over that which they possess for sulphuretted hydrogen. He proposed to use four vessels with ammoniacal liquor, on the same principle as that adopted with lime purifiers. In the first and second, the carbonic acid was to be entirely removed; in the third, the sulphuretted hydrogen would form the "sulphide" required for the removal of CS_2; the fourth vessel being used as a reserve for arresting any sulphuretted hydrogen which passed the third vessel. This action was to continue until the liquor in the first vessel became completely carbonated, when it was to be run off and replaced by fresh liquor. The carbonated liquor was to be revivified, or decarbonated, by means of caustic lime, when it would again be available for use.

At that time, several fairly successful attempts were made to purify the gas from carbonic acid and sulphuretted hydrogen by means of ammoniacal liquor. But apparently no method of extracting the carbon bisulphide by the same medium was actually attempted, though Patterson's proposal was considered feasible. It must be remembered that at the time it had only recently been discovered that, by the proper use of lime, it was possible to purify the gas from all three impurities, CO_2, SH_2, and CS_2. For several years before this, much pressure had been brought to bear upon the gas companies to compel them to reduce the sulphur compounds in the gas. This had been found impossible, owing to the fact that the formation of the "sulphide" material had not been discovered. It is only natural, therefore, that the relief resulting from this newly-acquired knowledge should have conduced to a policy of *laissez-faire*. Some years later, the Claus system was adopted in one or two gas-works; but beyond the moderate success with which this system was attended, little was done on a practical scale to prove whether the scheme of completely eliminating all three impurities from the gas by means of liquor was possible of attainment.

Present-Day Conditions.

At the present day, the desideratum is a less exacting one. The presence of carbonic acid in the gas, owing to the comparative ease with which the necessary illuminating power is maintained,

and owing to the fact that it has a proportionately small effect on the calorific power of the gas, is not considered of much importance. The sulphuretted hydrogen is obviously still as rigorously and as easily eliminated; while restrictions as to the amount of sulphur compounds in the gas have been very rightly removed for some years past. But the responsible heads of gas undertakings have carefully watched this question, and have set their faces against the presence of any abnormal amount of this sulphur in the gas they supply. In some cases, the use of lime has again been resorted to for the purpose of limiting the amount of this impurity to reasonable proportions.

There is, moreover, little doubt that were some simple, cheap, and inoffensive means of substantially removing the carbon bisulphide to present itself, most gas undertakings would adopt it, as no one disputes the fact that the gas would be better without it.

Possibilities of Hot Washing.

The writer has given much thought to this question, and for some time past has considered that a thorough washing of the gas with hot ammoniacal liquor at the point where it reaches the hydraulic main would be effective in extracting a quantity of the carbon bisulphide. With this idea in mind, he attempted to produce in the hydraulic mains conditions as favourable as possible by arranging that the liquor which was made in the retort-house, and which is fairly free from carbonic acid and sulphuretted hydrogen, should be collected and circulated through the hydraulic mains. The method of circulating the liquor was shown in an article on the "Arrangement of Tar-Towers" in the "Journal" for April 25, p. 225. The effect of this arrangement is that the liquor is churned over and over at practically the same temperature as the gas—only the surplus being allowed to flow away. The washing of the gas is obviously very imperfect; the time of contact being so short. But the writer thinks that it has a good effect. It is found that after a few days working in this manner, provided that no liquor is run in from an outside source, the fixed ammonia in the liquor gradually increases until it becomes present to the extent of four times the amount of free ammonia.

At this stage, it would probably be advisable to run off this liquor and fill up the tanks with liquor containing a larger percentage of free ammonia, as the fixed ammonia can have no possible effect in washing out any impurities from the gas. In future, the writer has determined to watch the relative proportions of free and fixed ammonia in the liquor, with a view to limiting the proportion of the latter. As a matter of fact, it is found that, although a surplus quantity of liquor is made in the retort-house which overflows into the storage tank, it is occasionally necessary to supplement the liquor in the two retort-house tanks from the main storage tank, owing to the tanks being of small dimensions and the difficulty of adjusting the pump to maintain the liquor in the tanks at convenient levels. The liquor is thus sometimes diluted, with the result that the fixed ammonia in the liquor is usually not much in excess of the free, though the strength of the liquor is rarely, if ever, below 9 or 10 oz.

Working in this manner (which may, for all the writer knows to the contrary, be the same as adopted by others), it is claimed that the sulphur compounds in the coal gas are at least extracted to a certain extent. To what extent, however, the writer has not been able to prove, though he has found that the sulphur compounds in the coal gas have certainly been reduced since this arrangement was adopted.

Small Quantity of Sulphur Compounds.

The writer has found that, under certain conditions (which he has had difficulty in reproducing), the coal gas only contained an average of 26 grains of sulphur compounds for a period of over three months. This was experienced last summer while working a single retort-house. As soon as a second, and larger, retort-house was put to work, fitted up as regards the method of working explained in this article in exactly the same manner, the sulphur impurities in the coal gas showed an immediate increase to a figure ranging from 26 to 36 grains. The writer was naturally anxious to again reproduce the satisfactory results experienced last summer; but the difficulty and work involved in investigating such matters, and the fact that the mixed gas supplied—usually 75 per cent. of coal gas and 25 per cent. of carburetted water gas—only contains an average of 25 grains of sulphur compounds, led to a postponement of any investigations.

Recently, however, the writer has again studied the matter, with a view to finding some solution to account for the low figures noticed last summer. They were experienced from the end of May until the middle of September; and the writer has formed the opinion that during these summer months the liquor in the tanks must have been much hotter, with the result that the liquor in use in the hydraulic mains would have been more completely decarbonated or purified from carbonic acid, and thus have produced more favourable conditions for the absorption of CS_2 by free uncombined ammonia and ammonium sulphides.

Conditions Existing in the Hydraulic Mains.

The writer may be wrong; but, rightly or wrongly, he considers that, in cases where the liquor used in the hydraulic mains is maintained in a sufficiently heated condition, the same action takes place, though in a very imperfect and crude manner, as was discovered by Mr. F. C. Hills in the late sixties. In Hills' process, the liquor to be purified from carbonic acid and sulphuretted hydrogen, already extracted from the gas, was heated to a temperature of 180° Fahr., which had the effect of driving off the two acid gases and part of the ammonia contained in the liquor. In this process, the proportion of ammonia driven off was washed back into the liquor—thus producing a purified ammoniacal liquor uncombined with acid gases and entirely suitable for purification purposes. The proportion of ammonia driven off by the high temperature is far less than the proportion of the acid gases, as may be determined by a simple laboratory experiment. Consequently, the liquor, after being heated, retains a quantity of uncombined ammonia. It is the latter which, in the opinion of the writer, has an important bearing on the possibility of washing out a considerable quantity of CS_2 from the gas while still hot. There appears to be no reason why the same effect, as exemplified in Hills' process, should not be reproduced in the hydraulic mains and the liquor tanks from which they are supplied. There is no doubt that, at a sufficiently high temperature, dissociation of the ammonium carbonates and sulphides takes place (liberating carbonic acid and sulphuretted hydrogen), and that the ammonia, which is much more soluble, is retained by the liquor.

Tilden, in his "Manual of Chemistry," states that "a process by which cyanides are manufactured is based upon the interaction which ensues when CS_2 is heated with ammonia, whereby a thiocyanate and a sulphide are formed."

Thus, $$CS_2 + 4\ NH_3 = NH_4CNS + (NH_4)_2S,$$

or the carbon bisulphide may combine with ammonia to form ammonium sulphocarbonate and ammonium sulphocyanide.

$$2\ CS_2 + 4\ NH_3 = (NH_4)_2\ CS_3 + NH_4CNS.$$

In connection with this matter, the following extract from a letter by Mr. R. H. Patterson, published in the "Journal of Gas Lighting" in 1875, is interesting:

> It is also the fact, as regards gas liquor, that Mr. Livesey mentioned to me, a day or two ago, that simply by heating it he had been able to obtain "a rough caustic ammonia," thereby showing that by this simple method he had been able to revivify the liquor to a considerable extent. I do not know whether Mr. Livesey is following up this experiment, or whether, by analysis, he ascertained the extent to which the liquor was actually revivified or rendered caustic. But I am sure it is well worth his while to do so; and no one is more capable than himself to work out this important question. Mr. Livesey told me that a high authority had said to him that, upon chemical principles, it is impossible that he could have obtained the result which he affirms he did. Probably this chemical opinion was based upon the remarkable volatility of ammonia, leading to the inference that the ammonia would be driven off by the heat before, or at least along with, the saturating acid impurities, CO_2 and SH_2. But against this theoretic judgment must be placed the remarkable affinity of ammonia for water, which is many hundred times greater than the affinity of the saturating acids in fouled gas liquor. In fact, water can only absorb $2\frac{1}{2}$ times its volume of SH_2 and only one volume of CO_2, whereas it can absorb nearly 780 times its own bulk of ammonia gas. In other words, the relative affinity of these substances for water stands thus: $CO_2 = 1$, $SH_2 = 2\frac{1}{2}$, $NH_3 = 780$! These facts, I think, may supply the true explanation of the generally unexpected result obtained by Mr. Livesey; and it seems to me that this remarkable superiority in affinity for water which ammonia has, compared with carbonic acid and sulphuretted hydrogen, supplies a good ground for hope that the revivification of gas liquor may yet be effected by very simple and almost costless means.

To prove to what extent ammonia is volatile at high temperatures, the writer tried the following experiment. A sample was taken from the liquor condensed in the retort-house, similar to that used in the hydraulic mains. It was found to contain 4 oz. of free and 8·4 oz. of fixed ammonia. It was observed that the acid gases (carbonic acid and sulphuretted hydrogen) were almost entirely absent. The behaviour of the free ammonia in the liquor, on being heated to high temperatures, is shown in the following figures:

At 150°	Fahr.,	the	strength	was	found	to	be	4·0	oz.	free (none lost)
,, 160°	,,	,,	,,	,,	,,	,,	,,	3·8	,,	,, (0·2 oz. lost)
,, 176°	,,	,,	,,	,,	,,	,,	,,	3·3	,,	,, (0·7 oz. lost)
,, 184°	,,	,,	,,	,,	,,	,,	,,	3·0	,,	,, (1·0 oz. lost)
,, 194°	,,	,,	,,	,,	,,	,,	,,	2·8	,,	,, (1·2 oz. lost)

Thus showing that the extreme solubility of ammonia in water is sufficient to overcome its volatility at even high temperatures.

Holgate states that the carbonates are dissociated at 136° to 140° Fahr., and the sulphides at about 95° Fahr.; and thus the uncombined ammonia represented by the hydrate at higher temperatures is available for combining with CS_2.

That this uncombined ammonia is present in the liquor from hydraulic mains is shown by Dr. Max Meyer and Herr H. Hempel, in a communication to the "Journal für Gasbeleuchtung" during August, 1908. The difference in the liquor that is condensed in the hydraulic main and that usually found in the works storage tank is shown in the table (p. 364).

When discussing the analyses, the following comments were made: "The hydraulic main liquor contained much less volatile ammonia, mainly as sulphide to the amount of one-fourth and carbonate to the amount of one-seventh of what they were in the general tank liquor. The cyanide also had fallen to one-third. This poverty is due to the higher temperature—say, 100° C.—in the hydraulic main. At such temperatures, these components are dissociated and pass on as gases." And, again, "In the tank liquor there was only 7·4 grains of free NH_3 per gallon; in the hydraulic main liquor, there was as much as 73 grains per gallon, which shows that dissociation of the sulphide and carbonate is active in the hydraulic main and ammonia, being more soluble, is detained there. The hydraulic main liquor is therefore better suited for wet purification processes."

Samples from—	Storage Tank. Grains per Gallon.		Hydraulic Main. Grains per Gallon.	
Ammonia total	1120·6		405·7	
Volatile	984·5		204·1	
Fixed	216·1		201·6	
	Salt.	NH_3.	Salt.	NH_3.
Ammonium carbonate	2468	875	332	117·9
,, sulphide	193	96·6	51	25·6
,, thiosulphate	86	19·7	30	6·9
,, sulphite	traces	..	0	..
,, sulphate	16	4·1	16	4·1
,, chloride	517	164·5	505	160·8
,, sulphocyanide	127	28·5	70	15·7
,, ferrocyanide	6·2	1·6	2·3	0·6
,, cyanide	8·3	3·2	2·4	1·0
Free NH_3		7·4	..	73·0

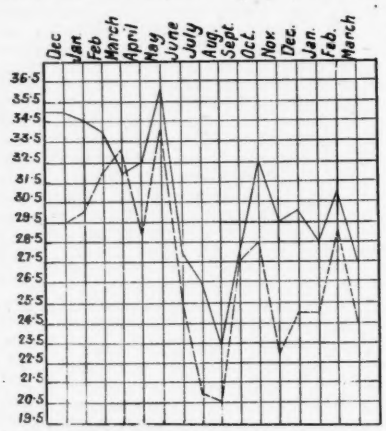
The writer considers that this table and the above extracts illustrate accurately what actually takes place in the hydraulic main, but considers that the temperature (100° C.) stated to exist in this part of the plant is rather too high. As regards the absorption of CS_2 by ammonium sulphides, which are formed to a greater or less degree in the hydraulic main, the following reactions probably represent what may be expected to occur:

$$(NH_4)_2\,S + CS_2 = (NH_4)_2\,CS_3$$
$$2NH_4\,HS + CS_2 = (NH_4)_2\,CS_3 + H_2S.$$

And, again, it is known that carbon bisulphide is absorbed by ammonium bisulphide (polysulphide) — $(NH_4)_2\,S_2$.

Average Quantity of Sulphur Compounds in Gas.

It will be noticed from the subjoined diagram, showing the results of the testings for sulphur compounds, that the average amount of this impurity has not been high at any time, either before or after the arrangement described was adopted. But it will be noticed that, low as it was previous to the continual



Black line—Coal Gas (tested at Works).
Dotted line—Mixed Gas as supplied (tested at Testing Station).

Diagram Compiled from Average Daily Tests of Sulphur Compounds, in Grains per 100 Cubic Feet.

circulation of the liquor, it is now lower, though not by any substantial amount. The same coals (Durham) have been used; and the same system of working as regards other details has been in force throughout the period from December, 1909, to March, 1911. The average of the daily tests for each month is shown in the diagram.

Effect of "Hot" Washing in 1864.

In connection with this question of washing the gas while still hot, the writer came across a short description [see "Journal" for Oct. 18, 1864] of a method of working at Nottingham in the early sixties. At that time, the sulphur impurities in coal gas were restricted by Act of Parliament to 20 grains; but this figure was continually exceeded, though at that time the gas rarely contained more than 30 grains. The low content was not due to any system of purification, but probably to the low heats then worked, and the imperfect system of testing, which was thought to indicate a portion only of the sulphur compounds in the gas.

It had been found that coal carbonized in iron retorts produced less sulphur compounds than that carbonized in clay retorts; but a case is mentioned in which this experience was reversed at the Nottingham Gas-Works, where, when using the same coal, it was ascertained that the gas from iron retorts contained 14·86 grains in 100 cubic feet, but from the fire-clay retorts only 7·41 grains. It was, however, explained that "at the station where clay retorts are used, the gas is washed previous to condensation with large quantities of the ammoniacal liquor pumped over and over again until it becomes offensively fœtid." At these works, the gas was thoroughly washed by a stream of ammoniacal liquor amounting to about one-sixteenth of the volume of the gas. This stream descended through a vertical scrubber of about 20 feet in height, and containing four pebble-filled trays; while the gas ascended at the slow rate of 2 inches per second. It was stated that by this means one-half of the bisulphide was removed, together with much ammonia and condensable tarry vapours.

This experience, though known at the time, was misapplied by others; for while a thorough scrubbing of the gas after condensation was very exhaustively tried on an elaborate scale by the Gas Referees at the various London Gas-Works, without any success whatever, nothing further was done to test the effect of scrubbing the gas before condensation and while still hot. As a matter of fact, it was found that, on the whole, scrubbing the gas after condensation actually increased the amount of sulphur compounds present in it.

Suggested Method.

To thoroughly test the effect of washing hot gas with heated ammoniacal liquor, a much more efficient washer than the ordinary hydraulic main is required. The gas must be split up, and must be brought into close and more prolonged contact with the liquor, if much good is to result from the treatment. The writer considers that one or more Livesey washers placed on top of the settings, and connected to the foul mains, would be admirably suited for the purpose. A steam-coil would be fitted in the washer to maintain the liquor at any desired temperature; while careful tests would be periodically carried out to ensure the liquor being kept in an active state for the removal of the impurity. The temperature at which the liquor would be most active, and the particular state in which it should be kept, would have to be ascertained by experiments.

As will have been observed, the writer's method of working has been quite haphazard, and no scientific experiments have been carried out. In fact, little out of the ordinary has been done, either in the method of working or in the reduction of the sulphur impurity. But it is thought that the points raised in this article, and the somewhat crude expressions of opinion, may at least ventilate what is both an interesting and an important subject.

The Joint Junior Association Meeting.

The full programme of Saturday's Joint Meeting of English Junior Gas Associations in Birmingham, which is now to hand, states that four morning visits to manufacturing firms have been arranged, all starting at 10.30; and members are invited to select the particular visit in which they would prefer to take part. The four works are those of Messrs. Parkinson and W. & B. Cowan, Messrs. John Wright and Co., the Wolseley Motor Works, and the Birmingham Aluminium Casting Company. The starting points for the different visits are set forth in the programme. There will be lunch in the Grosvenor Rooms at the Grand Hotel at 1.15; and in the afternoon there will be visiting parties made up for the four gas-works of the Birmingham Corporation; the visitors being again free to make their choice of the works they will inspect. These parties will be formed at the Grand Hotel at 2.30. On the invitation of the Birmingham Gas Committee, there will be tea in the Gas Department Recreation Rooms; and then for the evening three more alternatives are offered—a visit to the high-pressure show-rooms and laboratory, to the governor-house for augmenting the low-pressure supply (at King's Norton) from the high-pressure gas-main, or to the gas compressors and high-pressure gas foundry. Afterwards, the members will proceed to the National Trades Exhibition at Bingley Hall; and there will, of course, also be an opportunity for inspecting the excellent street lighting. For the convenience of those remaining in the city until a late hour, a room has been reserved at the Metropole Hotel from 10.30 p.m. until midnight. Guides and conveyances will be provided for each visit. The arrangements have been made by a Committee representing the Midland Association of Gas Managers and the Midland Junior Association; and now all that is needed for a thoroughly successful day is a large gathering of members from the different areas.

Association of Water Engineers.

The sixteenth annual general meeting of this Association will be held at Buxton from the 18th to the 20th inst., under the presidency of Mr. Edward Sandeman, M.Inst.C.E., the Engineer of the Derwent Valley Water Board. We learn from the programme issued by the Secretary (Mr. Percy Griffith, M.Inst.C.E.) that, by invitation of the Buxton Urban District Council, the business will be transacted in the Town Hall, where the members will be welcomed by Mr. W. F. Mill, J.P., the Chairman of the Council. Three papers have been promised: "The Geology of Dam Trenches," by Dr. Herbert Lapworth, F.G.S., Assoc.M.Inst.C.E.; "The Water Supplies of the River Basins of England and Wales," by Mr. W. R. Baldwin-Wiseman, Assoc-M.Inst.C.E., F.G.S.; and "The Filtration of Public Water Supplies and their Sterilization by Ultra-Violet Rays," by Mr. Walter Clemence and Dr. Rechlinghausen. The premiums awarded by the Council for papers read during the past session will be presented. On the afternoon of the first day, the members will visit Haddon Hall, passing Chatsworth *en route;* and on the 19th they will inspect, under the personal guidance of their President, the Bamford filters and the Howden and Derwent dams of the Water Board, and be invited by him to partake of luncheon. The annual dinner will be held at the Palace Hotel, Buxton, on the evening of the opening day.

RECENT DEVELOPMENTS IN BYE-PRODUCT TREATMENT.

THE BURKHEISER AND KOPPERS PROCESSES.

By G. Stanley Cooper, B.Sc.

In recent years the attention of gas engineers and chemists has been directed largely towards the production of sulphate of ammonia by some process more simple, yet less costly, than by the present method of distillation of the ammoniacal liquor. The problem has been attacked from two entirely different points of view; and in both cases such a measure of success has been attained as to warrant the commercialization of the processes. The two aspects of the problem are alike in the fact that their aim is to produce sulphate of ammonia by what is termed "the direct process"—*i.e.*, to utilize the ammonia in crude coal gas without having recourse to washers, scrubbers, &c., and finally distillation of the ammoniacal liquor obtained. In its widest sense, a truly direct process is an unattainable ideal, if we take it to mean that all distillation will be done away with. As soon as the hot gas leaves the retorts, condensation necessarily takes place, with the formation of some tar and ammoniacal liquor. The newest processes, therefore, are only semi-direct, as they all at some point or other involve distillation with lime in order to make use of all possible ammonia. The reduction of this distillation to a minimum is a task continually before those concerned.

Since coal gas contains sulphur and ammonia, the ideal process is surely to utilize both these substances in the formation of ammonium sulphate, without the use of external acid. The other alternative is to render the crude gas into such a condition that it can be relieved of its ammonia directly by means of sulphuric acid, without having to use any water at all, other than that obtained from the gas by condensation. Processes working on these lines have passed the experimental stage, and are now strongly established as commercial enterprises. Perhaps the most representative types are respectively the Burkheiser process and the Koppers process. Both these are of German origin, but are now established in this country, where their installations are sure to become familiar to all interested in the gas industry during the next few years. A short description and comparison of the two processes will perhaps serve a useful purpose in giving some insight into their working, and may further give a slight idea of their possibilities.

Both processes were originally intended for coke-oven practice, and both are equally applicable to gas-works. While the Koppers system has had a few years of successful commercial working, the Burkheiser system is still in its infancy in this respect; but its supporters are firmly convinced of its ultimate success. One of the strongest claims for support of the system is that it concentrates in one unit the processes of purification and bye-product recovery, and the plant required occupies only a fraction of the area covered by that of the old system. The Burkheiser plant differs in no way from the ordinary gas-works plant until after the tar-extractor. Following this, the gas-works practice of extracting first ammonia and then sulphur is reversed. The sulphur is first extracted by passing the gas through purifiers containing Burkheiser's patent oxide; the purifiers being worked in series in the usual way—three in use, one stand-by, and one undergoing revivification. It is in the processes of purification and revivification, together with the extraordinary activity of the oxide, that the value of the Burkheiser system lies.

This purifying material has been subjected to a special process by which organic matter and moisture are removed, leaving the oxide in small nodules about the size of a pea; and this special material, when maintained at the correct temperature, is capable of removing the sulphuretted hydrogen from twenty thousand times its own volume of the gas, and at a speed thirty times greater than ordinary oxide. During the process of regeneration of the fouled oxide, the sulphur compounds are oxidized to sulphurous acid, which passes through a scrubber and is absorbed.

It may occur to some readers that there is in this process a liability to accident owing to overheating during oxidation, as is met with during the process of ordinary revivification *in situ*. In the Burkheiser plant this is almost impossible, owing to the presence of water vapour in the air and water cooling of the oxide. The limit of safety is not reached until a temperature of over 300° C. is attained in the purifiers; while in practice the temperature rarely if ever rises above 140° C. Thus there is an ample margin. In order to be thoroughly safeguarded, an electric alarm thermometer is placed on the purifier being regenerated. After regeneration, the purifying mass is left in its original condition—containing no free sulphur, cyanides, or sulphide of iron.

After leaving the purifiers, the gas passes through scrubbers, through which a special lye obtained in the process is circulated. This lye consists of a solution of bisulphite of ammonia, NH_4HSO_3 and sulphite of ammonia $(NH_4)_2SO_3$. It is continually circulating round the plant, and during its travel absorbs all the sulphurous acid produced in the regenerating purifier. Thus the liquor is first taking up ammonia, then sulphurous acid, until at last the salt falls out of solution.

The process can well be illustrated by an example: At the commencement, pure water is used; and since the sulphuretted hydrogen is first absorbed, ammoniacal liquor free from sulphur is obtained in the scrubber. This liquor is used to absorb the sulphur dioxide from the purifier undergoing regeneration; and the following reaction takes place: $NH_4OH + SO_2 = NH_4HSO_3$. This acid liquor can now absorb more ammonia, and is therefore used again in the scrubber. Thus:—

$$NH_4HSO_3 + NH_3 = (NH_4)_2SO_3$$

This normal ammonium sulphite is capable of absorbing more sulphur dioxide, and is therefore used for this purpose. Thus:—

$$(NH_4)_2SO_3 + SO_2 + H_2O = 2NH_4HSO_3$$

We now have two molecules of the acid sulphite, instead of one as formerly; and so the whole process repeats itself. As this liquor circulates, it becomes more and more concentrated, and eventually the normal sulphite falls out of solution. The liquor never contains any free acid, nor is any acid or substitute used at any part of the process. Hence no lead work is required; and the original and maintenance costs are considerably reduced. The Burkheiser salt or ammonium sulphite produced in the process is oxidized to ammonium sulphate by means of air in a very simple and economical manner.

A point to be noted in connection with the process is the relationship between the amounts of sulphur and ammonia respectively available in gas manufacture. Nearly all gas coal contains sufficient sulphur to bind the ammonia; and, in fact, with English coals there is usually an excess of sulphur. This excess can be dealt with: (1) By passing it into the furnace gases; (2) by absorbing it in a limestone tower; (3) by adding more ammonia to the gas (obtained by the distillation of more liquor).

It is reported that two large plants are being erected in this country and several on the Continent, all of about 2 million cubic feet per day capacity; and the practical results from these installations will be watched with interest. Evidently, the results so far obtained are sufficiently satisfactory to warrant these large installations being erected.

The Koppers system is a process of the semi-direct type, but differs from the Burkheiser system in that the use of sulphuric acid is necessary. The old idea of absorbing the ammonia from coal gas by passing it through a bath of sulphuric acid usually brings in its train concomitant troubles with tar and sulphur in the saturator, owing to the difficulty of manipulating the strength of the acid in a satisfactory way.

In the old systems of sulphate making, it is necessary to maintain the acid in the saturator at steam temperature, in order to produce the sulphate. The affinity of ammonia for sulphuric acid weakens as the temperature rises; and it is partly due to the high temperature at which the saturator is worked that the sulphate contains a high percentage of free acid. In the Koppers system, it is arranged that the gas shall enter the saturator at a comparatively low temperature—usually about 50° to 80° C.

After leaving the retorts, the gas is condensed to a temperature of about 25° C., after which the tar is extracted. The gas is then led through a superheater, where it is reheated to the desired temperature by the hot gas issuing from the retorts. It is then led into the saturator, and the ammonia recovered in the form of sulphate by direct contact with sulphuric acid. The saturator is of the enclosed type; and the sulphate is removed by an injector.

The salt obtained is of exceptional quality, of a good white colour; the crystals being of large size. Samples made by the Koppers system examined by the writer yielded the following results:—

Moisture	=	1·7 per cent.
Free acid	=	0·64 ,,
Ammonia	=	25·23 ,,
Tarry matter	=	nil
Free sulphur	=	nil

It will be seen from the above that the sulphate produced is of exceptionally good quality; and the writer is firmly convinced of the reliability of the process generally.

The essential difference between the Burkheiser process and all other so-called direct processes is that the former is a complete process for producing a purified gas. All impurities which have to be removed on a gas-works are also removed on this system; and the fact that the whole process is accomplished, and the ammonia obtained as sulphate, without any expenditure on acid, is a strong point in its favour. The Koppers process, on the other hand, does not utilize the sulphur in the gas at all, but it has to be removed in the usual way by further purification.

In writing the above account, the author has endeavoured to state fairly and frankly the results of entirely independent investigation, and has no connection in any way with either of the processes outlined. So convincing, however, are the results authentically obtained by both the systems that one is compelled to believe that the next few years will witness a complete revolution in the methods of bye-product treatment and ammonia recovery.

The late Mr. John Spencer, of the Globe Tube-Works, Limited, Wednesbury, whose death in November last was recorded in the "Journal" at the time, left estate of the gross value of £38,920, of which £35,802 is net personalty. Among the bequests are £100 to build a reading-room for the men employed at the works, or in any other way the Executors may select for the benefit of the men; and £5000 to the University of Birmingham, to be applied in the advancement of science and in promoting the working-out of scientific problems or in such way as the Principal and Vice-Principal shall determine. Subject to other legacies and bequests, the testator left the residue of his estate to the University of Birmingham for like purposes.

SOUTHERNS AT WINCHESTER.

GLORIOUS old Winchester, with few rivals in the wealth of its historical associations, and of ancient monuments to an illustrious past, was the scene of the summer outing last Thursday of the members of the Southern District Association of Gas Engineers and Managers. The members travelled from near and far to assemble in the city upon the invitation of the Chairman of the Gas and Water Company (Mr. J. Charles Warner) and his colleagues and of the Engineer and Manager (Mr. H. C. Head), who is the President of the Association this year. The contingent of members from the London district and those whose best route was *viâ* London, of course, formed the majority of the company who travelled to Winchester. They had a special saloon carriage attached to the 10.15 Bournemouth express, which the South-Western Railway Company had consented to stop at Winchester for their convenience. It was a splendid run (only an hour and twenty minutes being occupied by it), and from what was gathered there was hardly a subject that is on the table at the present time for discussion that was not dealt with in the conversation that flowed during the journey. The Hon. Secretary (Mr. W. E. Price, of Hampton Wick) was indefatigable in taking advantage of having the members penned up in a railway carriage to see that certain small details associated with the official responsibilities the members have thought fit to impose upon him received attention. Among other things, Mr. Arthur W. Sumner, of Grays, received the distinction of having his nomination for membership ratified by the members sitting in a railway carriage. The time passed pleasantly; and at 11.40 there was a joining of forces, on Winchester platform, with the contingent from the south-west. Everything promised for a good day. The atmospherical conditions were right; there appeared to be a general buoyancy of spirits abroad; and there was an excellent programme that Winchester and Mr. Head, backed by his Board, had jointly been able to present.

A General View on the Winnall Gas-Works of the Winchester Gas and Water Company.

Two or three minutes walk from the railway platform brought us to the Gas and Water Company's Andover Road gasholder station; and there the members were introduced by the President to his Chairman (Mr. Warner) and to the other Directors present. It was regretted that Mr. W. H. Myers and Mr. Barrow Simmonds, jun. (members of the Board), could not be present; but the visitors made the acquaintance of the Vice-Chairman (Mr. W. Thorn Warren, J.P.), Mr. H. L. G. Hill, and Mr. A. W. Oke. Light refreshments were provided here. The visitors, however, did not linger long over them; there being a time-table that Mr. Head and Mr. Price were determined should be complied with as closely as circumstances would permit. We were therefore soon on brakes, driving towards the Company's new gas-works at Winnall. It is over five years ago since some of those present on Thursday were there taking part in the inauguration of these works, and wishing them profoundly and sincerely a prosperous and profitable career. The gas-works are wearing well. Though five-and-a-half years have passed, the whole place, with its ample room everywhere, seemed to be as spick-and-span as the day of the "opening" celebration. The visitors looked into the retort-house, and admired the compact settings and the completeness of the equipment; and they saw some of the retorts charged and discharged. The arrangement of the block of machinery buildings was also considered excellent. The exhausters are here; even the washing and scrubbing plant is considered worthy of a place under cover. The carburetted water-gas plant, the steam-boilers, and the sulphate of ammonia plant have also their allotted places in the same building. There is a precept at Winchester that, if plant is worth having, it is worth taking care of; and the taking-care of it does not cost so much money in the long run as neglect

[*Photos. by H. W. Salmon, Winchester.*

Another General View on the Winnall Gas-Works.

or carelessness. We "did" the round of the whole plant most thoroughly; not omitting the stokers' lobby, which is about the cosiest we have seen on moderate sized works such as these. There is an "ingle-nook" fire place in it in which stokers can comfortably place themselves in the breathing-times between work, and the place is fitted with all the essentials for personal cleanliness. The brown enamel-faced bricks used in the place enhance appearance and comfort.

SHORT DESCRIPTION OF THE WINNALL WORKS.

With his usual thoughtfulness, the President had prepared some notes descriptive of the works at Winnall, which were fully described and illustrated at the time of their inauguration towards the later part of the summer of 1905 [see "JOURNAL," Vol. XCI., p. 617]. The President's notes, however, give us the main features in very concise form; and we therefore reproduce them.

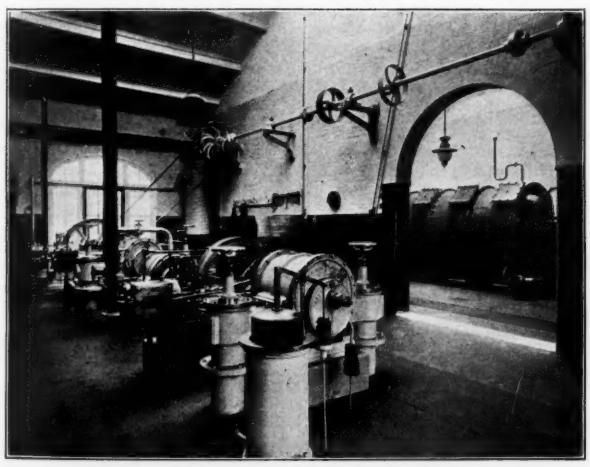
The supply of gas and water in the City of Winchester is now under the control of one Company; but prior to 1865 these every-day necessities were in the hands of separate undertakings. In May of that year, an Act of Parliament was obtained by which the two Companies who were responsible for the supply of gas and water were amalgamated. From 1865 to 1904 gas-making was continued at the old works in Staple Garden, where the Company's offices are still situated. Here, too, it was that the gas-holders were also situated for some years; but the whole of the ground space here available was, in course of time, required for manufacturing and purifying purposes only, and the holders had to be moved to another site. During this period, the sale of gas rose from 34 million cubic feet in 1876 (there is no earlier record, apparently before that time gas was not sold by meter) to 82 million cubic feet in 1904. In 1903, the Company went to Parliament for further powers of a financial and general character. These having been obtained, a piece of land situated about half-a-mile to the north-east of the city was acquired, and an entirely new gas-works erected thereon. The works were completed and brought into use in August, 1905. With new gas-works an increased output was possible; and the gas supply was extended to the districts of Compton, Shawford, Twyford, Otterbourne, Colden Common, and Harestock. The amount of gas sold now exceeds 100 million cubic feet per annum.

The works occupy 5 acres of ground adjacent to the Didcot, Newbury, and Southampton Railway Company's line, in connection with which there is a private siding capable of accommodating sixty waggons, and having special provision for unloading oil and sulphuric acid, also for loading tar; a 30-ton weighbridge being provided for weighing all goods handled. The coal-store and the retort-house adjoin.

The retort-house contains two benches. The first, erected in 1904, contains five settings of eight retorts each; the second, erected in 1906, contains six settings of six retorts each. Each bench is independent, with its own tar-tower and retort-house governor, so arranged that either governor can be used for both benches. A separate building fitted with washbasins, shower-baths, &c., forms the stokers' lobby.

The condensers are of the water-cooled type; No. 1 being that of Messrs. Dempster's make, and capable of dealing with 300,000 cubic feet per twenty-four hours. No. 2 condenser is of Messrs. Cutler's "Perfect" type, of a capacity of 600,000 cubic feet per twenty-four hours, and is the condenser which was formerly in use at Staple Garden. The mains from the retort-house are so arranged that both of these condensers can be used together, or either can be used alone—thus allowing the other to be bye-passed for periodical cleaning.

The exhausters are placed in the machinery buildings, where are also situated the washing and scrubbing plant, the carburetted water-gas plant, the steam-boilers, and the sulphate of ammonia plant. The exhausters are three in number, and are all of the Waller rotary type; two being coupled direct to steam-engines, and the third being driven by a gas-engine through a shaft which runs the whole length of the engine-room, and also drives the tar, liquor, and water pumps placed at the end of the room. The tar is removed in a Livesey washer capable of dealing with 600,000 cubic feet per twenty-four hours; and the gas is then passed through a Holmes rotary washer-scrubber of a similar capacity. Just outside the machinery buildings is a "Cockey" washer-scrubber, which was removed from the old Staple Garden works, and is used for stand-by purposes.



A View in the Machinery Buildings at the Winnall Works.

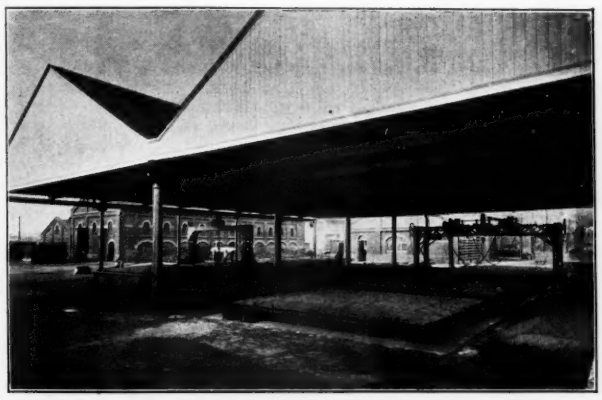
The purifiers are eight in number, arranged in two sets of four each, and in winter, during the period of maximum output, the gas is divided into two streams—as nearly as possible half being passed through each set of purifiers to the meters. The No. 1 purifiers are fitted with conduit grids and the No. 2 purifiers with hurdle grids; and at the present time they are charged with Dutch oxide and Westbury oxide respectively.

The station meters are two in number, one connected to each set of purifiers.

The water-gas plant is that supplied by Messrs. Humphreys and Glasgow to the Staple Garden works in 1896. When installed, the estimated capacity was 225,000 cubic feet per diem. On removal, the then existing generator was replaced by one of larger size; and the capacity of the plant was increased to 350,000 cubic feet a day. Apart from the generator, the whole of the plant, including the combined oil-tank and relief holder, is as originally supplied; the only addition being an oil-feeding arrangement, duplicating the oil-pumps. The water gas is measured through a rotary meter, and is mixed with the coal gas at the inlet to the exhausters.

The boiler-house at the north end of the machinery buildings contains two Lancashire boilers, 26 ft. long by 6 ft. 6 in. diameter, steaming at a pressure of 100 lbs. per square inch. Either is sufficient to supply the whole of the steam required throughout the works, and both are fitted with Wilton's patent forced-draught furnaces for breeze burning.

The sulphate of ammonia plant is situated at the south end of the machinery buildings, and is capable of producing a ton of sulphate per diem. The coke-breaking plant, erected in 1910, is self-contained, with its own building, gas-engine, elevator, overhead breaker, and separating-screens for breeze. It is capable of breaking 4 tons of coke per hour.



The Purifier-House at the Winnall Works.

The offices and the yardmen's lobby are close to the entrance; the former being provided with a 5-ton road weigh-bridge.

From the works the gas passes through some 1½ miles of 14-inch main to the holders, which are three in number, and have a total capacity of 400,000 cubic feet. One holder is situated in Water Lane in the lower part of the city, and the others are in Andover Road adjacent to the London and South-Western Railway Station, where are also the district governors and a Sturtevant fan, driven by a 10 H.P. gas-engine, for augmenting the pressure of the gas on the inlet to the governors.

The President, in explaining the features of interest about the works, was helped by Mr. P. Drewett (Senior Assistant-Manager) and Mr. J. M. P. Valon (Junior Assistant-Manager).

Luncheon at the Royal Hotel.

After a thorough examination of the works, the brakes were again boarded, and a pleasant drive took the large party to the Royal Hotel, where they were entertained by the Chairman and Directors of the Company. The Chairman (Mr. J. Charles Warner) presided, and his colleagues (named earlier in this report) were also present. The Company have recently met the Corporation in the Parliamentary Committee-rooms over the question of the purchase of the electricity works by the latter; but this made no difference to the presence of the Mayor (Mr. J. S. Furley) and other representatives of the civic life of Winchester. In addition to the members of the Association and the Mayor, the guests included Mr. J. A. Pearson, the Chairman of the Rural District Council, Rev. A. G. Joyce, Rector of Winnall, Mr. F. Faithful, Clerk to the Winchester Rural District Council, Mr. T. Holt, Town Clerk, Mr. R. J. Harris, Mr. N. C. H. Nisbett, Mr. E. Dowling, and Mr. W. Tanner.

The luncheon was a liberal one, and excellently served; and the morning's outing had put a keen edge to the appetites of the visitors. After a full enjoyment of the good things, four toasts were proposed and honoured—the first being "The King."

Mr. W. Thorn Warren, J.P. (the Vice-Chairman of the Company) then proposed the toast of "The City of Winchester." He said he was honoured by having to submit the toast on behalf of so many representatives of the gas industry. They were honoured by the presence of His Worship the Mayor. They were reminded by this that many mayors, aldermen, and magistrates had throughout the country been members of the directorates of gas undertakings; and they had done noble work—work involving the accumulation and wise spending of large capitals, work involving much of an experimental nature, and work for which they did not always earn public gratitude. But these men had done the work, and had assisted in the development of this important service in household requirements. To the men who had accomplished this pioneer work, they ought to be grateful. In Winchester they were indebted to the Mayor and Corporation for their enterprise, and energy in connection with the advancement of the city. As an instance of prosperity, he might say that in the last six months the output of gas had been greater than had been known in the history of Winchester; and he had full assurance that the prosperity of the city would continue in the future.

The Mayor, in reply, remarked that the flattering terms in which the toast had been proposed and the cordiality of the reception was a great satisfaction to him. It was a pleasure to see the members of the Association in their city. The Gas Company had done, and were doing, a great service to the city. He was not quite sure whether the Mayor of Winchester ought not to have expected a warm reception of another order. Doubtless those present were aware of recent events which had apparently, on the surface, drawn the Corporation and the Gas Company into some antagonism. But his own belief was there was ample room for both the Gas Company and the electricity undertaking; and when he looked around the room, and heard the vigorous talk, he could not think that these were the representatives of a decaying or dying industry. [Laughter.] If he might judge from words and from appearance, he should say that the gas industry was fully alive. In Winchester curious days had been seen; but he thought that the city had also proved that gas was an increasing and an undying institution. If there was one industry above all others that had shown conspicuous powers of recuperation, that industry was the one of gas supply. The more they cut into it, the faster it shooted. Vigorous life was one of the excellent characteristics of the Winchester Gas and Water Company. He was not very old, but he remembered the streets

of Winchester being lighted by oil. That was their state of barbarism twenty years ago; but in the twenty years the gas industry had made strides unequalled by any other. He did not think the Gas Company had much to fear from the electric light. It was an old saying that they could not have too much of a good thing; and if there was one thing in the world they did want, it was more light. The Company and the Corporation were combining forces for the Coronation, and for plenty of illumination then; and taking all these things into consideration, he did not think their quarrel was really a serious one. He thanked the Chairman and Directors and all present for the kindness received, which showed the friendly way in which they desired to live in the interests of the city.

The CHAIRMAN, in proposing "The Southern District Association of Gas Engineers and Managers," expressed the pleasure of his colleagues and himself in receiving as their guests so many of the men engaged in the gas industry. As gas directors they could express their appreciation of the great services which the engineers of their various undertakings rendered to the concerns and to the advance of science. They had present many distinguished members of the profession; and it was a great pleasure to have them there, if only because the President of the Association was a valued friend of his own. Mr. Head had been with them in Winchester for some time; and it was no secret that the sale of gas in the city had gone up by many million cubic feet during the period. From Mr. Head they had received devoted and successful service; and they held his services in very high appreciation. In receiving the members of the Association, the Directors felt that they were paying a compliment to Mr. Head through their guests.

Mr. HEAD, responding to the toast, said he did not know how to adequately express his appreciation, either on behalf of the Association or of himself, of the very kind remarks his Chairman had made. However, he did most sincerely, in the name of the Association, thank the Board for their very kind reception; and there would be another occasion on which he could better say how much he personally appreciated the kindness. He believed he was correct in saying that they had a record gathering on this occasion; and this, he thought, was due not less than anything else to the great attractiveness of the city of Winchester. The presence of the members was almost as great a compliment to the Mayor, as his presence was to the members. On such an occasion as this, the members highly appreciated the presence of the Mayor, of the Chairman of the District Council, and of leading inhabitants; and it gave to the visit the tone of a real public reception. He hoped that one and all of the visitors would carry from the city very pleasant recollections.

Mr. H. W. WOODALL (Bournemouth) said he had been asked to propose what he was bound to consider the toast of the day—that was, "The Winchester Water and Gas Company;" but he wished someone had been chosen who was more capable than he of expressing their high appreciation of the generous way in which they had been entertained. He supposed the Southern District Association would continue to exist if there were no summer meeting; but he thought the value of the Association would be greatly depreciated, because it was on this particular occasion that the members had an opportunity of meeting, more or less intimately, the gentlemen who were the directors of the gas companies, and without whose support and interest the value of the Association and the work done by it must be considerably curtailed. No Englishman could turn his steps towards Winchester without respect for the city which could be termed the cradle of the British race. No city was richer in archæological and architectural matters than was Winchester. Excellent though the local guide-book was, there was one matter that was not mentioned, and without which no city in ancient or modern times could exist—a matter which must have been one of anxiety to the city for over 2000 years. That was the question of the water supply, the works now associated with which they had not been able to see that day owing to want of time. But they had seen one of the works of the Winchester Gas and Water Company; and wherever else in Winchester there might be signs of ruin and decay, they were not to be found at the gas-works. They all knew that, when they came to Winchester, they would see in works which were fortunate enough to have Mr. Head to control them, every sign of progress and vitality; and they had not been disappointed. A more charming works he had not been privileged to see; and the Company were to be congratulated upon them, as the members of the Association were in having had the opportunity of visiting them. No one could appreciate more keenly than the members the kindly spirit in which they had been entertained by the Directors; and it was with the sincerest pleasure that he gave the toast, coupling it with the name of Mr. Warner.

The CHAIRMAN thanked Mr. Woodall for the kind way in which he had spoken of the Company and of the Directors. It was a great pleasure to see Mr. Woodall present, because his father was the adviser and designer of their works at Winnall, as well as a personal friend of his own. He also thanked the members for the way in which they had received the toast. He would not detain those present by talking about the Company; more especially as he had "foes" both to his left and to his right. [Laughter.] They had lately returned from a skirmish in an exalted atmosphere, whence they both came back poorer than they went. But it was a real pleasure to meet their opponents in social intercourse that day. The Mayor was an old schoolfellow of his own; and he had the same desire that he had, that the best interests of Winchester should be served. The Directors of the Company had much enjoyed the visit of the members of the Association; and they hoped the visitors would spend the afternoon in acquiring a fuller knowledge of the beauties of the city.

CATHEDRAL AND COLLEGE.

The large company were shortly afterwards photographed on the lawn at the back of the hotel; and they then emerged into the streets of the city for the purpose of investigating the wonders and work of the ages now deep in history. They first of all visited the Cathedral, and were received by Canon Vaughan, who, in the time remaining before afternoon service, showed them some of the beauties of the sacred and famous pile. The Cathedral Architect (Mr. N. C. H. Nisbett) then took charge of the party, and escorted them round the exterior of the Cathedral, explaining to them the work in progress in strengthening the structure, and pointing out the main features of the great building, of the Close, and other parts. Then Winchester College was visited, and several of the renowned parts were inspected. It was an interesting and instructive afternoon; and with such excellent guides, it would have been real pleasure lost to have missed it.

Tea was served at "God Begot House;" and just before six o'clock, adieus having been said to the President and the hosts, the members were all homeward bound.

WALES AND MONMOUTHSHIRE DISTRICT INSTITUTION OF GAS ENGINEERS AND MANAGERS.

Half-Yearly Meeting at Bargoed.

The heart of the steam-coal district of South Wales had been selected for last Wednesday's meeting of the Institution—and a place, withal, where the members would be able to make themselves personally acquainted with the utilization of coke-oven gas for supplying the ordinary requirements of a district. Bargoed—the spot referred to—is in the area of supply of the Rhymney and Aber Valleys Gas and Water Company, who furnish gas to a very large district; and for some time past Bargoed, Aberbargoed, and Pengam have been supplied with coke-oven gas, received from the Powell Duffryn Steam Coal Company. The way that this is carried out was explained by the Gas and Water Company's Engineer, Mr. A. W. Branson, who received the members; and the meeting was followed by an inspection of the coke-oven plant. Thus, though the business portion of the proceedings was short, the fixture proved an interesting one for those who took part in it, though it must be confessed it would have been more enjoyable under less unfavourable meteorological conditions.

THE BUSINESS MEETING.

When the members assembled at the gas-works (where a room had been placed at their disposal for the meeting by the Directors of the Gas and Water Company), the chair was taken by Mr. J. H. CANNING, of Newport, the President. Letters of apology for absence were read from Mr. Alexander Wilson (the President of the Institution of Gas Engineers), the Presidents of the Manchester, Eastern Counties, Midland, Southern, North of England, and North British Associations, Mr. George Andrews, and Mr. E. H. Swain (who had met with a slight accident).

MINUTES OF THE LAST MEETING.

The HON. SECRETARY (Mr. Octavius Thomas, of Pentre) first read the minutes of the last general meeting; and they were confirmed by the members.

NEW MEMBERS.

The following new members were next elected: Mr. James A. Brentnall, Manager of the Abercarn Gas-Works, and Mr. J. P. Jones, Assistant-Manager of the Rhymney and Aber Valleys Gas and Water Works.

ANNUAL REPORT.

The HON. SECRETARY read the sixth annual report of the Council, which stated that during the year six members had joined the Institution and two had resigned—leaving a membership of 59 at the end of the year. The receipts amounted to £30 19s. 6d., and the payments to £29 13s. 4d.; there being, with the balance brought forward from the previous year, a sum of £22 12s. 10d. in the hands of the Treasurer. A copy of the Reports of the Proceedings of the District Associations had been sent to all the members who had paid their subscriptions. A Special Purposes Section had been formed, and steps were being taken to put it into working order. The Council had had under consideration the formation of evening classes in gas manufacture and supply. A gas supply class had been arranged at Cardiff, and had been very successful. One was put in hand for Pontypridd; but, having failed to obtain a teacher, the class fell through. The Council hoped, however, to be successful in the coming session.

The PRESIDENT said he thought they would agree with him that both the statement of accounts and the report of the work of the Council and Institution for the past year were highly satisfactory, and showed that good progress had been made. As the members were probably aware, there had that morning been held the first meeting of the Special Purposes Section, which was intended to assist the members in connection with all questions, commercial

and technical, affecting the interests of gas-works in the district of the Institution; and the Council trusted that as many undertakings as possible would see their way clear to join this most useful section. The report with regard to the education of gas-fitters was hardly so satisfactory. A class had been started at Cardiff, and had met with every success. There was also every prospect of a successful class being inaugurated at Pontypridd; but it had been found impossible to obtain a teacher. Then at Newport and one or two other centres, arrangements had not yet been fully come to with the local authorities as to the classes and the provision of accommodation for them. He had pleasure in proposing the adoption of the report and accounts.

Mr. R. A. Browning (Neath) seconded the resolution, which was at once agreed to.

Election of Office-Bearers.

The following were the officers elected for the ensuing year:—

President.—Mr. E. H. Swain, of Pontypridd.
Senior Vice-President.—Mr. G. T. Andrews, of Swansea.
Junior Vice-President.—Mr. T. E. Franklin, of Barry.
Hon. Treasurer.—Mr. Henry Morley, of Teignmouth.
Hon. Secretary.—Mr. Octavius Thomas, of Pentre.
New Members of Council.—Mr. Thomas Canning, of Newport, and Mr. J. Mogford, of Briton Ferry.
Hon. Auditors.—Mr. George Clarry, of Cardiff, and Mr. F. C. White, of Treharris.

The President, in proposing the election of Mr. Swain as President, said none of the members need be told anything about this gentleman, as they all knew him and would agree that he would make an excellent occupant of the chair, and carry out the duties in a thoroughly satisfactory manner. Mr. Swain, whose technical knowledge was of a high order, had been among them for a number of years, and had endeared himself to everyone by the admirable traits of his character and his geniality.

Subscription to the Gas Institution Benevolent Fund.

The President pointed out that last year the members decided to subscribe the sum of £2 2s. to the Benevolent Fund of the Institution of Gas Engineers; and he thought they ought to continue their subscription to so deserving an object. He therefore proposed that they should again subscribe £2 2s.

This was agreed to.

Place of Next Meeting.

Mr. T. E. Franklin (Barry) proposed, and it was unanimously carried, that the place of next meeting should be left open.

A Presentation to the Hon. Secretary.

The President remarked that the next matter was one that did not find a place on the *agenda;* but it was one that he approached with the greatest possible amount of pleasure. As they would remember, it was decided a short time ago to endeavour in some way to mark the appreciation of the members of the excellent services which the Honorary Secretary, Mr. Octavius Thomas, had rendered the Institution since the commencement; and with this view a small Committee—consisting of Mr. A. H. Brookman, of Tenby, and Mr. George Andrews, of Swansea—took the matter in hand and approached the members as to raising a small fund in order to carry out the intention. He was pleased to say that the response had been admirable on the part of the members. Unfortunately, Mr. Brookman had found it impossible to be present at the meeting; and Mr. Andrews was also exceedingly busy, but had written pointing out that the thanks of the Institution were due to Mr. Thomas for the very successful way in which he had carried out his duties. It had been the wish of the Sub-Committee that he (the President) should ask Mr. Thomas Canning to make the presentation to Mr. Thomas; but before doing so, he would like to add his personal testimony to the worth of Mr. Thomas's services to the Institution. He had known Mr. Thomas for a matter of something like twenty years. Their Secretary used to be a close neighbour of his; and he had therefore had an opportunity of knowing all his sterling worth, his personal qualities, and his kindness. As far as the Institution were concerned, they could never in any way adequately testify what they owed to him. There was no doubt that most of the success of the Institution—if not all—had been due to the untiring efforts of Mr. Thomas; and they had this to thank him for. He was not speaking altogether of the technical work of the Institution. They knew what this had been; and they knew how it had brought the members into touch with one another, and how they had been able to extend their knowledge by means of it, and to improve themselves. But he wanted to speak, too, with regard to the other side of the Institution. It had established a species of brotherhood among the members; and they must thank Mr. Thomas for this, and for the loyalty among themselves—that threefold loyalty which formed the cement of an Institution like this. That was, the loyalty to the undertakings which employed them, the loyalty they owed to the great industry they helped to carry on, and also loyalty to each other.

Mr. Thomas Canning, speaking amid applause, said it afforded him the greatest pleasure—and he felt it an honour—to make this presentation to Mr. Thomas in the name, and on behalf, of the members of the Institution. Perhaps one reason why he had been asked to carry out this, to him, most grateful task was because he had known Mr. Thomas for so long. He had, in fact, known him during almost the whole period of his official career. Six years would in a short time have elapsed since the Institution was inaugurated; and for a year before that Mr. Thomas was endeavouring to bring about this organization, which he (the speaker) believed had been of use, and which was likely to become very much more useful in the future. An Institution took some time to grow and develop; but whatever it might grow to, or whatever it might develop into, the Institution undoubtedly owed more to Mr. Thomas than to any other single individual, no matter who he might be. He need not dwell upon Mr. Thomas's courtesy—it was unfailing. The work of getting the members together, and of keeping them together, had been heavy; and it had been carried out admirably by Mr. Thomas. Besides, however, the work he did as Secretary, they must look upon him in another light. They must regard him in his own place, and in his own home. He held no sinecure in the Rhondda Valley; and that he had succeeded very well in circumstances of great difficulty must be generally acknowledged, and reflected the greatest credit upon him. In addition to all this, he was a very worthy and highly respected member of the community among whom he lived; and this they always took as reflecting to a considerable extent upon themselves. Under these varied circumstances, he had much pleasure in informing Mr. Thomas, on behalf of the Institution, of their desire to make him, not what they would consider an adequate recompense for his services, or anything of the kind, but a present which would in some small measure show him the extent of their gratitude, and which would also at the same time be expressive of their appreciation both of his merits and of his services. The presentation was cordially taken up by all the members of the Institution. He hoped that Mr. Thomas would live long to make use of the gift, and that his future career would be as prosperous as it had been successful up to now.

[He then handed Mr. Thomas a handsome dressing-bag, beautifully fitted up throughout.]

Mr. Thomas, in acknowledging the present, said he was very grateful to the members. When attending meetings of the Gas Institution in London and other places, he often felt that they in Wales wanted an organization of their own; and this was the reason for starting it. But he could assure them that the work had been a labour of love; and he was only thankful that it had proved to be of some use to his brother managers.

Votes of Thanks.

The President proposed votes of thanks to the Chairman and Directors of the Rhymney and Aber Valleys Gas and Water Company for the use of the room in which the meeting was being held, and to the Chairman and Directors of the Powell Duffryn Steam Coal Company for their hospitality and kindness in permitting the members to inspect the coke-ovens and bye-products works. The plant, he remarked, was one of the finest of its kind in the kingdom.

The votes were cordially passed.

Further Consideration of Mr. Thomas Canning's Paper on the Thermal and Thermo-Dynamic Efficiency of Town Gas in Practice.

The President said the next business was the further consideration of the paper, on the "Thermal and Thermo-Dynamic Efficiency of Town Gas in Practice," which Mr. Thomas Canning read at the last meeting of the Institution at Newport.*

Mr. Thomas Canning (Newport) remarked that since the publication of the paper he had been asked various questions with respect to the comparative cost per brake-horse-power-hour of different fuels and the electric current. He need hardly say that statistics of this kind were very difficult to obtain with accuracy, and in any case could only be put forward tentatively. Still, these were the very statistics that were after all of the most practical value to the gas manager in his daily work. His object in the paper which was put before the members at the last meeting (and which he hoped they had not yet entirely forgotten) was to deal with another point not exactly relating to cost, but to the power which was concentrated in the various fuels, which, applied in the manner best suited to each of them, gave the highest percentage of efficiency in working. This, in a long sentence, explained what was put so very nicely in the two words when combined together "thermo-dynamics." He did not, as he said, go into the question of cost. Since that time, however, he had made as careful investigation as he could himself into the cost, for example, of a brake-horse-power-hour with gas of a good calorific value, and had endeavoured to make a comparison in the same way between this result and what was obtained for the electric current. Not wishing to put before the members these figures entirely as the result of his own examination, he had compared them with others which had been given as the outcome of many careful tests by one whom he regarded as the best man—or, at any rate, one among the very best men—for carrying out such researches. He referred to Mr. Dugald Clerk. The figures for town gas, coal, and oil which he (Mr. Canning) would give the members were really more the result of Mr. Dugald Clerk's tests than of any of his own. All he could say was that the few tests he himself had been able to make in connection with gas were well borne out by those given by Mr. Clerk; and he had long ago published the results with respect to the working of the electric motor. He hoped the members would find the following figures of some use to them. The cost of town gas per brake-

* See "Journal," Vol. CXII., p. 42.

horse-power-hour, assuming it to reach the very good standard of 600 B.Th.U per cubic foot, which was rather high (in fact, somewhat too high for ordinary gas) would be: With gas at 1s. per 1000 cubic feet, 0·30d.; at 1s. 6d., 0·39d.; at 2s., 0·48d.; and at 2s. 4d.—that was the price of gas for power at Newport—0·54d. He had chosen the standard of 600 B.Th.U. per cubic foot, because this was the power of the gas with which Mr. Dugald Clerk made his tests. Steam in a steam-turbine, with coal at 8s. 6d. per ton, would cost 0·72d. per brake-horse-power-hour; an electric motor, with current at 1d. per unit, 0·75d.; and oil, at 6d. per gallon, 0·63d. He had quoted these figures already in one or two cases; and the possibility was that they might before this have become circulated. He had not, however, hitherto given them in so public a way as he was doing that day. He thought they would be generally found to be correct—that was, as near the point of accuracy as they could get in tests of this kind. The costs he had given included everything in all cases. The work as far as the electric motor was concerned was carried out in his own case with a motor which was new and working up to its full rated capacity. In regard to the gas-engine, this was not new, nor of the newest type; but it was a good engine by one of the first makers, and the experiments were carried out with it working up to only about one-half its rated capacity. This fact, in itself, taught them another lesson. Of course, if this gas-engine had been working up to its full rated capacity, the results would have been better even than those he had quoted; but the lesson which the experience taught was this: The engine was selected because it was of the same rating as the electric motor; and yet, in spite of this fact, working at only one-half its rated capacity, it did the same work as the electric motor. He added these few practical points in order that they might lead to discussion, and in the hope that the figures might assist members to make comparison between different fuels as to their thermo-dynamic energy. He would be pleased to answer any questions that he could.

The President said he was sure they were all much obliged to Mr. Canning for the pains he had taken to embody in one paper such a great deal of valuable information. There was one personal point he might mention with regard to the paper and the particulars contained in it. He sent a copy of the paper to a gentleman who was closely interested in matters of this kind; and apparently, from observations he made subsequently, he read it carefully through. At any rate, he said he had gone into the figures which were given at the commencement of the paper with regard to the heat developed per pound of different fuels, including gas, coal, and oil; and then he asked how it was he saw it stated there that gas would develop so much more heat per pound than oil, because the following was his own experience: He took a kettle containing a measured quantity of water, which he boiled upon the ring of a gas-cooker; and a certain time was occupied in the process. But he had an oil-stove (probably it was one of the blast oil-stoves), and putting the kettle on this, with the same quantity of water at the same temperature, he found it boiled in a shorter space of time on the oil-stove. He (the President) asked him how much gas he had used in the first instance, and how much oil in the second case; but unfortunately the reply was that he had neglected to obtain these slight details. (Laughter.) The trouble was, however, that this gentleman was actually about to infer from this fact the superiority of oil over gas as a fuel—absolutely ignoring, apart from the question of relative heating value, the convenience, reliability, cleanliness, and ease of using gas as compared with oil. He merely mentioned this to show what they sometimes met with. There was not much time on the present occasion for dealing adequately with the paper; and, of course, the discussion of a paper always suffered by having to be postponed, as had been the case with Mr. Canning's contribution.

Mr. C. H. Carder (Cardiff) said there was just one point which occurred to him—though it was possibly somewhat extraneous to the paper—and that was the effect of Professor Bone's researches, communicated in London, on the efficiency that they could reckon upon getting from gas. Professor Bone claimed, by applying the principle of surface combustion to the gas-firing of steam-boilers, a thermal efficiency of nearly 95 per cent. This gave them a thermal efficiency which they had not hitherto anticipated reaching; and if the system could be commercially adopted for use with gas-fires, it would furnish them with better results than could at present be obtained with these appliances.

Mr. J. E. Kenshole (Merthyr), referring to the figures just given by Mr. Canning, inquired whether it was a modern boiler that was used for the experiment with steam. He pointed out that the price of coal was given as 8s. 6d. per ton; but the pattern of the boiler with which it was employed would make all the difference in the world. They generally complained that people did not use gas so as to secure the best efficiency; and possibly the same thing had been done with the coal.

Mr. Canning replied that it was a Lancashire boiler with which the test in regard to coal was made; and the steam was used in a turbine. He did not know that he had anything else to answer.

A Call to the Younger Members.

Mr. Canning went on to remark that he thought it would be a very good thing if the younger members of the Institution would be less backward than they were at present in coming forward at the meetings, both to discuss papers and to produce papers of their own. Many of the members, both senior and junior, were in various ways much better qualified than he was himself to submit papers to the meetings; and if only they overcame a little of their diffidence and contributed something to the proceedings, they would feel that they were assisting to carry out the work which the Institution was intended to accomplish. He was sure that there was a great deal of ability among the members; and it was desirable that they should begin to know it themselves. He wished very much to make this a most successful Institution; and this would be done if members would come forward and state their views regarding the very important industry in which they were engaged—an industry which was growing every day. The moment they took the first step, by giving the results of their own experience on one or other of the points which were of interest and value in connection with the gas business, they would find the rest easy.

The President said he would like to echo Mr. Canning's remarks with regard to the reading of papers—not so much on his own account as President, but by way of an appeal on behalf of the Secretary, who experienced great difficulty in providing fare for the different meetings. If the members would make up their minds to come forward a little more readily, it would assist Mr. Thomas immensely, and would at the same time add greatly to the advantage to be derived from the meetings.

Proposed Alteration of the Special Purposes Section Rules.

The President then gave notice that at the next meeting in September he would bring forward a proposed alteration to Rule No. 2 relating to the Special Purposes Section, so that it should read as follows:

> "Membership of the section shall be open to any gas undertaking whose engineer and manager is a member of the Institution and shall represent such undertaking upon the Committee of the section, on payment to the Hon. Treasurer of the Institution of the sum of 10s. 6d. in the case of undertakings whose make is below 50 million cubic feet per annum, and one guinea in the case of undertakings whose make is above 50 million cubic feet per annum, upon registration and subsequently upon the 1st of October every year. In addition to representatives so elected, the section may, on the recommendation of the Committee of the section, co-opt persons, not exceeding three in number, who, by reason of their professional knowledge and experience, are qualified to assist in advancing the objects of the section."

He pointed out that it was necessary, under Rule No. 5, that notice of any proposition for amending the rules should be given at a general meeting of the Institution, and that such notice should appear on the *agenda* issued to the members for the following general meeting. The proposition he wished to make in regard to the alterations of Rule No. 2 was with the object of enabling them to do what they were not at present empowered to carry out, and that was to co-opt, if necessary, members, not exceeding three in number, from outside the members of their own Institution. The number was strictly limited, as before; but at present they could only co-opt three members from their own body.

This concluded the business portion of the proceedings.

COKE-OVEN GAS SUPPLY.

The Bargoed works of the Rhymney and Aber Valleys Gas and Water Company are not extensive, inasmuch as the immediate neighbourhood—Bargoed, Aberbargoed, and Pengam—is supplied with gas which the Company take from the Powell Duffryn coke-oven plant. In this way, a population of some 20,000 people are supplied with coke-oven gas; and the Company are arranging to deliver it as far as Caerphilly, where they have one of their coal-gas works. As a matter of fact, the top and bottom parts of the Company's district are at present supplied with coal gas; and it is the middle portion to which the coke-oven gas is furnished. The district is a rapidly growing one; for when the Company first took it over in 1898, the population supplied with water was about 23,000, whereas now the population of the area is some 70,000. At present the annual output of coal from the Rhymney Valley is about 5¼ million tons; and it is anticipated that in course of time this quantity will be doubled, as other steam-coal pits are either being or will be sunk.

The coke-oven gas (which is part of the Colliery Company's surplus, after they have taken what they require for generating power, &c.), is taken from the colliery holder into the gas-works holder; a Donkin exhauster, driven by a gas-engine, being used as a booster for this purpose when the condition of the storage renders it necessary. When the coke-oven gas is received, Mr. Branson says, it is of about 8½-candle power; and it is enriched either on its way into or out of the holder up to some 16-candle power. For this purpoe, 90 per cent. benzol is used, to the extent of about one-third of a gallon per 1000 cubic feet. The gas as received is practically free from sulphur, which is removed at the colliery by means of oxide purification. The Gas Company therefore merely put it through lime purifiers to take out the carbon dioxide.

The coke-oven gas has been supplied to the gas-works since the latter part of 1907; and in the intervening period the Company's consumption has doubled—the increase having been largely in this particular part of the district. There are works at Hengoed, not a great distance away, from which the Company can, if needful, supply the Bargoed area with both coal gas and water gas. Remarking that the gas when received is a very good coke-oven gas, Mr. Branson pointed to the following analysis: Carbon

dioxide, 2·01 per cent.; oxygen, 0·42 per cent.; carbonic oxide, 5·21 per cent.; ethylene, 0·80 per cent.; hydrogen, 63·42 per cent.; methane, 23·14 per cent.; and nitrogen, 5 per cent.

THE COKE-OVENS AND BYE-PRODUCTS PLANT.

Proceeding to the Powell Duffryn Steam Coal Company's works, the party were received by Mr. J. M. Greenhow (the Mechanical Engineer in charge of the colliery), Mr. H. L. Molyneux (who is in charge of the bye-products plant), and other officials, and straightway conducted to the imposing power house, where, on the invitation of the Chairman and Directors, refreshments were partaken of. Some time was spent round the 1200 B.H.P. and 2400 B.H.P. gas-engines, used for generating electrical power for the collieries; and then an inspection—which had unfortunately to be carried through in a heavy downpour of rain—was made of the coke-oven and bye-products recovery plant. It is unnecessary to say much about this here, as readers will find a lengthy descriptive article (with illustrations of the arrangement of the plant, the coke-ovens and one of the large gas-engines) on referring to the "JOURNAL," for May 12, 1908 (pp. 353-355). The calorific power of the gas produced by a mixture of small coals is 460 B.Th.U. per cubic foot gross; and of this about 50 per cent. is used in the oven-flues—leaving a balance of 50 per cent. available for power production. In normal working, it is said, the make is 120,000 cubic feet per hour, which leaves a surplus of 60,000 cubic feet per hour, for utilization under boilers and in the engines—and also, of course, for the supply of the Bargoed Gas-Works. The gas is purified by oxide of iron; and the Company make the sulphuric acid which is required for the sulphate plant. The excellent colour of the sulphate of ammonia (which is made in a Wilton apparatus) was, by the way, remarked upon by several of the members. Some figures of cost in connection with the operations of the coke-oven plant will be found in the issue of the "JOURNAL" already referred to.

The inspection completed, the party proceeded to the Bargoed Junction Hotel, where they were the guests at tea of Mr. Branson.

TAR TREATMENT OF ROADS.

Specifications for Tar.

The newly constituted Road Board have just published a series of general directions and specifications relating to the construction and maintenance of roads, which will be helpful to those who are responsible for the public highways.

The first specification, which gives minute directions for the execution of surface tarring, contains the following provisions in regard to tar:

The tar should be applied as soon as the boiling-point is reached, and over-boiling should be avoided. The desired temperature will be generally found in practice to lie between 220° Fahr. and 240° Fahr. in the boiler.

The tar shall be derived wholly from the carbonization of bituminous coal, except that it may contain not more than 10 per cent. of its volume of the tar (or distillates or pitch therefrom) produced in the manufacture of carburetted water gas. The specific gravity of the tar at 15° C. (59° Fahr.) shall be as nearly as possible 1·19; but, in view of the great variation in specific gravity of the tars produced in various parts of the country, the specific gravity may be as low as 1·16 or as high as 1·22, provided that in other respects it complies with the provisions of the specification.

The tar shall be commercially free from water—*i.e.*, it shall not contain more than 1 per cent. by volume of water or ammoniacal liquor, which water or liquor (if present) shall not contain more ammonia, free or combined, than corresponds to 5 grains of ammonia per gallon (= 70 milligrammes per litre) of the tar. On vigorous agitation for a quarter of an hour with 20 times its volume of water at 21° C. (70° Fahr.), the tar shall not impart to the water more than 5 grains of phenoloid bodies, reckoned as phenol, per gallon of water (= 70 milligrammes per litre).

The following provisions apply to tar coming from gas-works:

The tar shall be solely the natural bye-product of the manufacture of illuminating gas (coal gas with or without admixture of carburetted water gas), and shall have been subjected to no other or further treatment than may be necessary for the abstraction of water or ammoniacal liquor and light oils. On distillation the tar must yield below 170° C. not more than 1 per cent., and between 170° C. and 270° C. not less than 16 per cent. and not more than 26 per cent., of distillate (exclusive of water). The free carbon shall not exceed 16 per cent. of the weight of the tar.

The succeeding provisions apply to tar coming from distilleries. They are as follows:

On distillation, the tar must yield below 170° C. not more than 1 per cent., and between 170° C. and 270° C. not more than 26 per cent., of distillate (exclusive of water). The distillate shall remain clear and free from solid matter (crystals of naphthalene, &c.) when maintained at a temperature of 30° C. for half-an-hour. The distillation shall be continued to 300° C., and the residual pitch thus obtained shall not amount to more than 73 per cent. of the weight of the tar. The free carbon shall not exceed 16 per cent. of the weight of the tar.

A second specification refers to tar which is specially recommended for re-tarring roads. It is similar to the first specification down to the words "manufacture of carburetted water gas" at the end of the first sentence in the portion already quoted. Then the specification proceeds as follows:

If pitch be added to the tar in order to secure the specific gravity and proportion of residual pitch referred to below, the pitch so added must also have been derived from tar of the foregoing description. If oil be added to heavy tar or pitch in order to secure the specific gravity and proportion of residue referred to below, the oil so added must be derived from tar of the foregoing description, and must be practically free from naphthalene and tar acids or phenols.

The specific gravity of the tar at 15° C. shall be as nearly as possible 1·21, and in no case shall it be lower than 1·18, or higher than 1·24.

On a vigorous agitation for a quarter of an hour with twenty times its volume of water at 21° C. (70° Fahr.), the tar shall not impart to the water more than 5 grains of phenoloid bodies, reckoned as phenol, per gallon of water (= 70 milligrammes per litre).

The tar shall be free from water, and, on distillation, shall yield no distillate below 140° C., nor more than 3 per cent. of distillate up to 220° C., which distillate shall remain clear and free from solid matter (crystals of naphthalene, &c.) when maintained at a temperature of 30° C. for half-an-hour. Between 140° and 300° C. it shall yield not less than 15 per cent., nor more than 21 per cent., of the weight of the tar. The free carbon shall not exceed 18 per cent. of the weight of the tar.

The following are the specifications for commercial soft pitch and tar oils:

The pitch shall be derived wholly from tar produced in the carbonization of bituminous coal, except that it may contain not more than 10 per cent. of pitch derived from tar produced in the manufacture of carburetted water gas. On distillation, the pitch shall yield below 270° C. not more than 1 per cent. of distillate, and between 270° C. and 315° C. not less than 2 per cent. and not more than 5 per cent. of distillate. The free carbon should not exceed 22 per cent. of the weight of the pitch; but if it be found difficult or unduly expensive to obtain this quality of pitch, a quality containing as much as 28 per cent. of free carbon may be used with a reduced proportion of sand as filler.

The tar oils to be used shall be derived wholly from tar produced in the carbonization of bituminous coal, or from such tar mixed with not more than 10 per cent of its volume of tar produced in the manufacture of carburetted water gas. The specific gravity of the tar oil at 20° C. shall lie between 1·065 and 1·075. The tar oils, after standing for half-an-hour at 20° C., shall remain clear and free from solid matter (crystals of naphthalene, &c.). The tar oils shall be commercially free from light oils and water—*i.e.*, on distillation shall yield not more than 1 per cent. of distillate below 140° C. The amount of distillate between 140° C. and 270° C. shall lie between 30 per cent. and 50 per cent. The proportions by weight in which the pitch and tar oils are to be mixed shall be as follows: Pitch, 88 per cent. to 90 per cent.; tar oils, 10 per cent. to 12 per cent.

It is mentioned that the specifications are not intended to displace or discourage the use of any of the proprietary articles now employed for the treatment of road surfaces.

PROTECTION OF WATER SUPPLIES.

This was the subject of a paper read before the Society of Engineers, on Monday last week, by Mr. H. C. H. SHENTON, the Vice-President.

The author dealt with the difficulties of deciding on standards of purity for water and of danger from pollution. The warnings of Dr. Somerville and Dr. Thresh as to the harmfulness of certain organisms other than those usually taken into account were quoted; and Dr. Russell M'Lean's warnings against the harmfulness of coli, Dr. Sims Woodhead's statement as to the impurity of chalk waters, Dr. M'Weeney's coli standard, Dr. Rideal's comments on the coli standard, Dr. Houston's object in the purification of London water supplies, and Mr. Dibdin's statements with regard to coli—were all discussed.

In the author's opinion, standards could not be adopted that would ensure safety from all possible dangers, including unknown causes; but standards could be adopted that would exclude such germs as were known to be harmful. For the rest, a risk must be accepted or ignored till the existence of anything harmful in the water was proved or disproved by the scientist. Such standards should be rigidly enforced. If the scientist would fix such a standard, the engineer could make water conform to it. Mr. Shenton also stated that the fact that waters could be purified did not afford any excuse for permitting pollution to occur. All possible sources of pollution should be excluded, or purified so as to be harmless where exclusion was impossible. Engineers could do away with all sources of danger as required by constructing new and better works of various kinds; but these must be of a character superior to what was now generally accepted. To do away with the sources of pollution would prove less expensive in the end than present acquiescence in the construction or use of leaking sewers, house connections, drains, and the like, in places where pollution of the underground water supply was possible.

Income-Tax Allowance for Depreciation of Gas Plant.—The appeal in respect of an allowance for depreciation on plant and machinery on behalf of the Armagh Gaslight Company, Limited, which was argued by Messrs. W. A. Schultz and Co. before the Special Commissioners at Armagh on the 13th of October last, when the principle of an allowance for depreciation was granted, and the amount left over for further consideration, has now been settled. The allowances have been agreed at the following rates: Machinery and retort-benches, 5 per cent.; gas-mains, 2½ per cent.; meters and stoves, 10 per cent.

NORTH OF ENGLAND GAS MANAGERS' ASSOCIATION.

Half-Yearly Meeting at Newcastle.

The members of the North of England Gas Managers' Association held their sixty-eighth half-yearly meeting in the Lecture Theatre of the Institute of Mining and Mechanical Engineers in Newcastle on Saturday. Mr. J. Lewis, of Newcastle, presided. The meeting proved a very interesting one to the large turn-out of members who were present.

Apologies for Absence.

The Hon. Secretary (Mr. H. Lees, of Hexham) intimated that letters of regret had been received from several gentlemen who were unable to be present. Mr. A. Wilson, of Glasgow, the President of the Institution of Gas Engineers, wrote stating that he was sorry he should not be able to attend the meeting. They were, he said, very busy in Glasgow now; and there were many meetings in connection with the Institution to attend to. There were also letters from Mr. J. H. Canning, of Newport, President of the Wales and Monmouth District Institution of Gas Managers, Mr. W. Whatmough, of Heywood, Hon. Secretary of the Manchester District Institution of Gas Engineers, Mr. J. H. Brown, of Nottingham, the President, and Mr. Harold E. Copp, of West Bromwich, the Hon. Secretary, of the Midland Association of Gas Engineers and Managers, Mr. J. W. Auchterlonie, of Cambridge, the President of the Eastern Counties Gas Managers' Association, Mr. H. C. Head, of Winchester, President of the Southern Association of Gas Engineers and Managers, and others.

The Late Mr. J. Grant.

The President said they would be aware that, since the last meeting, the Association had lost one of their oldest members. He referred to the late Mr. J. Grant, of Sunderland. Mr. Grant had the good fortune to be able to complete his jubilee of active service with the Sunderland Gas Company. He would be kindly remembered by all those who were intimate with him; and he was sure that it would be their desire that a letter of sympathy be sent from the Association to the relatives who had sustained the loss. He begged to move that this be done.

It was unanimously agreed to.

The Annual Accounts.

The Hon. Secretary said every member had received a copy of the accounts for the past year; and there were not many features which required that attention should be called to them. There was, however, one which he thought ought to be mentioned. They were dipping into their accumulated funds. There was no cause for alarm; but it would be necessary for the Committee to make some suggestion to the Association as to the state of the funds. He begged to propose the adoption of the accounts.

Mr. W. Ford (Stockton) seconded; and the motion was agreed to.

New Members.

Mr. Charles L. Ireland, Gas-Works, Annfield Plain, was admitted a member; and Mr. Francis Lacey, Dowsland, Heaton, was admitted an associate member of the Association.

The Benevolent Fund of the Institution.

The President said that last year they had an appeal from the Institution of Gas Engineers with regard to the Benevolent Fund. The matter had again been before the Committee; and they had pleasure in proposing that the Association give a donation of five guineas to the Benevolent Fund of the Institution.

The Hon. Secretary, in seconding, said that last year it was suggested that members of the Association might contribute to the fund. This had been done to some extent; and he was glad to say that some of those who contributed then had now become permanent subscribers to the fund. He had come across a minute of the Association of thirty years ago, in which it was stated that they contributed ten guineas to a Benevolent Fund. If they could do this when they had a comparatively small income, he thought the Association could afford the contribution which was now proposed.

The motion was unanimously agreed to.

Technical Business.

Mr. F. C. Willis, of Tynemouth, read a paper on "High and Low Pressure Distribution Schemes at Tynemouth" (see p. 375).

The President said they had all listened with very great interest to Mr. Willis's able and valuable paper; but time was getting on, and they should have to adjourn the discussion upon it. This was accordingly done.

Lecture by Professor Phillips Bedson.

The President next introduced Professor P. Phillips Bedson, M.A., D.Sc., who had arranged to deliver a lecture on "Teclu's Method of Ascertaining the Heating and Illuminating Power of Coal Gas." He said no doubt many of those present were aware that Dr. Bedson was Professor of Chemistry at the Armstrong College, which was a branch of the Durham University. They were honoured by his presence that day; and in the name of the Association he offered him a hearty welcome.

Professor Bedson then delivered his lecture, which will be found on p. 373. At its close,

Mr. W. Doig Gibb (London) said they had that day had a happy combination of theory and practice—a combination essential to present-day conditions. Dr. Bedson's name was too well-known in the North of England, as a scientist, for him to have to say anything in this connection; but he might remark that they had all listened with very great pleasure to his interesting and instructive lecture. In Mr. Willis he was particularly interested, as he had opportunities, in his younger days, of studying and admiring his careful, methodical, and accurate work; and he was quite sure that in the paper he had given them that day these high qualities were reflected. Personally, he was not at all sorry that the discussion had been postponed, because the paper raised too important a subject for a discussion upon it to be cut short; and he ventured to say that the next six months would give many of them greater experience upon the subject than they now had. Mr. Thomas Hardie—Mr. Willis's chief—had been kind enough to suggest that, when the paper came on for discussion, Mr. Willis might be able to give more extended figures of the results of his experiments than he had been able to secure for his paper. He begged to move that the thanks of the Association be tendered to the two gentlemen who had been kind enough to place their services at the disposal of the members that day.

Mr. C. Dru Drury (Sunderland) seconded, and remarked that those of them who had attended the interesting lectures and the brilliant demonstrations of Professor Bedson, would not readily forget them. They would always have the esteemed privilege of being able to say that Professor Bedson had associated himself with them, to a certain extent, in their investigations into questions of purification and the like. All this would be fresh in their minds; and he was sure they all esteemed it a great honour to have had him there that day. As to Mr. Willis's paper, they expected good things from Tynemouth, and they had not been disappointed. He thought it was the reader of a paper from Tynemouth who first brought before the Association the practice of illustrating papers by means of the lantern, by which very much interest was added to a paper.

The motion was carried with great cordiality.

Professor Bedson, in acknowledgment, said there were some matters which he thought might be of interest to them as gas managers; and he was glad that he had been able to give them a lecture upon these matters.

Mr. Willis said that if there was to be any discussion upon his paper, he should be very pleased, with Mr. Hardie's permission, to furnish any further particulars which might emerge.

Election of Office-Bearers.

The Hon. Secretary intimated that the result of the ballot for the election of office-bearers was as follows:

President.—Mr. H. Tobey, of Malton.
Vice-President.—Mr. C. H. Armstrong, of Wallsend.
Auditor.—Mr. W. Garbutt, of Newcastle.
Hon Secretary.—Mr. Herbert Lees, of Hexham.
Members of Committee.—Mr. T. Waddom, of Newcastle, and Mr. F. P. Tarratt, of Darlington.

The President congratulated Mr. Tobey upon his election to the chair. Most of them were aware that this would be the second time he had filled the office.

Mr. Tobey thanked the members for the honour they had done him in electing him their President for the second time. It was a long while since he occupied the chair—something like a quarter-of-a-century; and in this time he had seen a good many changes in the membership of the Association. He had great pleasure in asking them to hold their next meeting at Malton.

Votes of Thanks.

Mr. F. P. Tarratt (Darlington) moved a vote of thanks to the President and the other office-bearers. The President gave them an address on a subject which, he believed, had not been previously touched upon. He had also been the means of securing two excellent papers for that day. They had had a most useful year. The Special Purposes Section had been brought into practical operation during the twelve months; and he wished to say that those members who were not connected with it were missing a great deal. He would urge upon the members who had not been able to persuade their boards or committees to allow them to join the movement, to again take it up.

Mr. G. S. Sayner (Harrogate) seconded; and the motion was adopted unanimously.

The President, in returning thanks, said that the chief reason which made him go into the chair was the fact that it was the first time a distribution engineer had occupied any chair; and he thought this was a recognition which had not come too early. He asked them to give a special vote of thanks to the Council of

the Institute of Mining and Mechanical Engineers for the use of their Lecture Theatre.

This was cordially agreed to; and the meeting came to an end.

The members and their friends, to the number of considerably over a hundred, dined together later in the County Hotel, with Mr. LEWIS in the chair.

Professor BEDSON, in proposing the toast of "The North of England Gas Managers' Association," said he had the most sincere sympathy with the object of the Association, because this object brought together what he had always contended should be a mutual support to each other—science and industry. The association of science and industry always appeared to him to be particularly well illustrated by the history of the gas industry. He could not select more suitable examples of the way in which science and industry mutually benefited than those which were afforded by the relation of the gas industry to organic chemistry. Organic chemistry was but the chemistry of the hydrocarbons; and they were dealing every day with these hydrocarbons. The gas manufacturer had provided the chemist with materials, which the chemist had converted into substances of the greatest possible service to man. Modern chemistry was really very much the outcome of investigations into gases.

The PRESIDENT, in acknowledging the toast, referred again to the Special Purposes Section, which, he said, had now been in existence for about ten months, and had already done valuable work. They met monthly; and their proceedings were divided into two sections. First, they had what was known as impromptu business, in which anyone might bring up any matter he wished information upon. Then they had special subjects, of which due notice had been given, so that data could be procured and given at the meeting. They had had before them the questions of prepayment-meter collections, coal and coke prices, stocks, incandescent mantles for street lighting, and income-tax and depreciation. One subject had occupied them at four meetings, and was likely to do so at more. This was the method of obtaining an increased average consumption of gas per consumer. They had fifteen undertakings, with twenty-one representatives. It was a surprise to him that there were not more members. Those who had not joined evidently did not recognize the value of the work which was being done.

The toast of "Kindred Associations" was proposed by Mr. H. TOBEY, and responded to by Mr. R. G. SHADBOLT, of Grantham.

The proceedings closed at an early hour in the afternoon.

TECLU'S METHOD OF ASCERTAINING HEATING AND ILLUMINATING POWER OF COAL GAS.

By Professor P. PHILLIPS BEDSON, M.A., D.Sc.

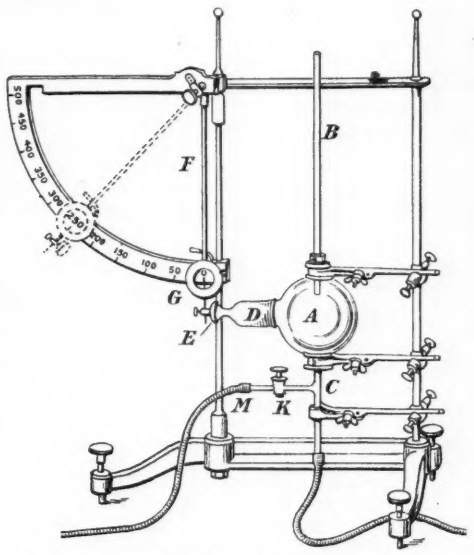
[A Lecture to the North of England Gas Association last Saturday.]

The matter which I am bringing before you, with very considerable diffidence, is, I feel, one which, in a public Association like yours, may appear to be of a very elementary character. At the same time, I hope to be able to show you that it has a bearing which is not without a practical interest. It is a subject, in fact, which brings into prominence an aspect of the bunsen burner and the principles underlying it—an aspect, or philosophy, of which, notwithstanding the almost universal use of this appliance, is not one to which men's minds are usually directed. We do not generally look upon the bunsen burner as a means of providing us with an explosive mixture of gas and air; and yet, as Teclu has shown, it may be so modified as to give a method of automatically providing an explosive mixture, and from the behaviour of which, as Teclu has shown, conclusions may be drawn as to the heating and the illuminating power of the gas under examination.

The force produced by the combustion of a given volume of a mixture of inflammable gas and air is essentially dependent upon the temperature of combustion of the mixture; and this, in turn, is influenced by the heat of combustion of the gas in question. So, as Teclu suggests, the measurement of this explosive force may be utilized as data from which to draw conclusions as to the calorific power of an illuminating gas.

[The lecturer then explained the apparatus devised by Herr Teclu. It is shown in the accompanying illustration, which appeared, with full descriptive particulars, in the "JOURNAL" for May 4, 1909, p. 298.]

The method of working is the following: The lower tube having been connected to the gas supply, and the tap on the side tube closed, the seconds watch is started, and simultaneously the gas is turned on. To expel air, the gas is allowed to burn, or to pass through the apparatus, for about 15 seconds. Then a light is applied to the open tube; and the gas is allowed to burn for other 30 seconds, when the gas is turned off. We have then set up the usual phenomena underlying which we have the bunsen burner. Through the several openings air has been drawn in, and as the explosive mixture has been found, the flame alters in appearance, in the well-known manner. It gradually loses its luminosity, and finally it separates into two cones. Then, after a time, the inner cone passes down the tube and ignites the explosive mixture in the glass globe. The explosive force expends itself in expelling the gases through the three openings. Inasmuch as the apparatus is made in definite dimensions, these are observed. Although in this way you do not get the whole of the explosive force which is developed or exerted, on the basin attached to the pendulum, you get an aliquot part of it, and you get the same aliquot part each time.



Teclu's Apparatus for Ascertaining the Heating and Illuminating Power of Coal Gas.

[It consists of the glass globe A, of 1 litre capacity, with three tubulures each 0·8 inch wide. The tube B, 13¾ inches in length and ½ inch bore, is fixed by means of a cork tightly in the upper tubulure; while the upper end of the gas supply tube C, which is 4¾ inches long and 0·4 inch bore, enters the lower tubulure. This tube has a side arm M, with glass tap K. The lateral tubulure D of the globe is narrowed at its mouth to ⅛ inch. The cap E, forming the bob of the pendulum F, fits loosely over the mouth of the tubulure D. On the pendulum rod above the cap is an aluminium ring G, with a pointer traversing (when the pendulum swings out) the millimetre scale shown on the quadrant. The scale extends from 0 at the base of the quadrant to 500 mm. at the top. There is a stop to prevent the pendulum swinging back in the opposite direction. The lower end of the bottom tube C is connected to the gas supply.]

It is evident, then, that the production of the explosive mixture, and its ignition, are automatically regulated. The length of the tube fitted into the upper opening at the mouth of which the gas burns, is an important matter. It must not be of such a length as that the flame, in its passage downwards, is cooled to extinction; and yet it must be of a length sufficient to ensure enough air being drawn into the globe to form an explosive mixture. The length of the tube used has been found by direct experiment.

A series of determinations has been made and published by Teclu, with the ordinary town gas supply of Vienna, in which the deflections of the pendulum observed vary between the limits of 248·5 and 271·5 mm. For the purposes of comparison and calibration of the apparatus, the explosive effect produced by burning in the apparatus, under equal conditions, a mixture of equal volumes of hydrogen and marsh gas was found to be equivalent to a deflection of 247·6 mm. I will cite a few cases. Taking the extreme cases I have named, it is evident that the calorific value of the town gas exceeded that of a mixture of equal volumes of marsh gas and hydrogen by from 0·36 to 9·65 per cent. One cubic foot of such a mixture of marsh gas and hydrogen has a calorific power of 706·5 B.Th.U.

The bearing of this information on the illuminating power of coal gas, when used in the incandescent burner, the intensity of the light from which is dependent on the temperature of the combustion, is sufficiently evident, and requires no further remark. You see by this means how you can ascertain the calorific power of coal gas; and the utility of this in connection with the use of gas in the incandescent burner is self-evident. The application of the results of experiments with Teclu's apparatus to the estimation of the illuminating power of the gas, dependent upon the light produced by the separation of carbon in the flame during the process of combustion, is not at once quite evident; but in experimenting in the manner which I have described, when the gas supply is shut off the flame takes an appreciable time to burn down and ignite the explosive mixture. The length of time in which the burning-down (striking-back) is effected is determined very largely by the density of the gas. If the gas is of light density; it will diffuse very rapidly; and an explosive mixture will soon be formed. As Teclu points out, the length of time in which the striking-back is effected can be utilized as a means of estimating the illuminating power of the gas. The lighter the gas, so much the more readily will it flow out of the apparatus, and so much the more readily will the air be drawn in. Consequently, the burning-down of the flame is greatly accelerated. With a heavier gas, the mixture

takes place more slowly, and the time is somewhat longer. In this connection, and in support of this, Teclu gives the results of a series of ten observations, showing that, for coal gas, the time of the burning-back varies from 34 to 35 seconds; while with a mixture of equal volumes of marsh gas and hydrogen the time was found to be uniformly 27 seconds. Taking this value as a standard, it is shown that the coal gas used exceeds in illuminating power the mixture of marsh gas and hydrogen by amounts varying from 25·9 to 29·6 per cent. Between the time of burning-back and the deflection of the pendulum, Teclu points out, there exists a certain proportionality which is fairly constant, and which in the cases cited lies between 7·8006 and 8·048. An admixture of carbon dioxide and carbon monoxide, while increasing the density of a gas, may produce a retarding effect on the time of burning-back, and might therefore lead to incorrect conclusions which might seem to indicate an increased illuminating power of the gas. But inasmuch as in Teclu's method the explosive effect is simultaneously determined, and the presence of these gases would have the effect of lowering the calorific value of the gas, the presence of such gases would be indicated in a disturbance of the proportionality existing between the time of burning-back and the deflection of the pendulum.

Having, for an altogether different purpose, used part of Teclu's apparatus—viz., for estimating the explosive force developed in the inflammation of mixtures of coal dust and air—I have rearranged it so as to use it for the purpose for which it was originally intended; and I am therefore in a position to give you some demonstrations upon it. You must understand that the apparatus which I show you is more or less of a makeshift. It is, of course, not exactly a reproduction of Teclu's, and I do not get, perhaps, as exact results as can be obtained with a more workmanlike piece of apparatus. But, at the same time, with the experiments which I have made, I have satisfied myself as to the possible utility and the possible potentialities of the matter. This, I think, is my excuse for bringing the matter before you. The working of the apparatus depends, in the first place, on the principles underlying the bunsen burner. To illustrate the working of that burner, we have an apparatus here which shows very well the explosive mixture at the moment of striking-back. Then I have here an apparatus which represents something of the character of the apparatus Teclu has described. This apparatus can be used to show the differences between gases of varying composition. [The lecturer demonstrated the working of the apparatus.]

I may pass at once, I think, to the application of the phenomena of the burning of gas in a bunsen burner, of which Teclu has made use. I have written upon the blackboard a few figures which indicate some of the results which can be obtained by the use of this device:

Time.	Deflection.	Calorific Power.	Candle Power.
Seconds.	Millimetres.		
22·3	277·5	140·7 gross 126·8 net	16·8
21·8	287·0	145·7 gross 130·8 net	17·8
22·4	265·0	127·5 gross 117·6 net	12·2
28·7	272·0	..	..
27·7	267·5	..	..
30·1	276·0	..	..

These experiments, which were made, through the kindness of Mr. Hardie, at the Elswick Gas-Works yesterday and the day before, show the time of the striking-back, the mean of several operations, which agree pretty well with one another, as 22·3 secs. The deflection is given as 277·5 mm.; and the calorific power of the gas was determined at 140·7 gross. Another gas gives, in time to burn down, 21·8 sec., and the deflection, as 287 mm., with a calorific power of 145·7 gross. Taking another gas, specially poor, for the purpose of trial, the burning-down time was given as 22·4 sec. There is not very much difference there; but there is a marked difference in the deflection, which is 265 mm., and the calorific power is 127·5 gross. Supposing you make the first of these numbers a standard for the purpose of calibration, and calculate from the deflection the calorific power of the second sample, it comes out, by calculation, at 145·5 calories; while in the case of the third sample the calorific value, calculated upon this basis, would come out at 134. This experiment is in favour of the gas, as against the calorimeter.

Some experiments were made to bring out the effect of adding some carburetting material to the gas—a course which has the effect of increasing its density, and has consequently an effect on the time of burning-back. I think I can show you, qualitatively, the difference between the coal gas and the same gas after its luminosity has been increased by carburetting. I will first of all take the time of striking-back of the coal gas. The time, you will observe, is 17 seconds. Now I will take that gas and pass it through cotton wool on which a little benzene has been sprinkled. You will see, I think, now that it is lighted, that there is a difference in the illuminating power. The time of striking-back is 21 seconds. There is an apparent difference there. This difference was shown better in the experiments at the gas-works yesterday, in which we got, on the time of burning-back of ordinary gas, in a number of experiments, 22·4 seconds, and the deflection 26·5 mm. Passing the gas through cotton wool containing benzene, the time was 28·7 seconds, and the deflection 272. This, of course, increased the calorific power of the gas. Another set of experiments with benzene gave the time as 27·7 seconds, and the deflection as 267·5. Then we had experiments with gazene, in which the time was increased to 30·1 seconds, and the deflection was 276. We also attempted some experiments in which we carburetted gas with naphtha. These experiments bore out the same conclusions; showing that there is a close connection between the burning-down time and the illuminating power of the gas, as contended for by Teclu. [The figures given in Professor Bedson's notes, with naphtha, are: Time, 27, 26, 26, and 25 sec.; deflection, 26·5, 25, 24·5, 25; and $\frac{D \times 10}{T}$, 9·83, 9·63, 9·42, 10.]

I must, in conclusion, apologize for having had to use my own apparatus, and having so few of my own observations to show upon it; but the potentialities of this method of testing coal gas appear to me so great, and the information obtained so valuable, that I have ventured to draw your attention to it, in the hope that some of you may be induced to apply it in practice, and that ultimately the method may become standardized by the accumulated experience of those who may use the apparatus.

The following are the results of the experiments at the Elswick Gas-Works referred to by the lecturer:—

May 4, 1911.

[Pressure and rate the same in every case.]

Sample	Candle Power.	Calorific Power. B.Th.U.	Time. Seconds.	Distance Millimetres.	Dist., Mm Time, Secs.
I.	16·8	140 7 gross 126·8 net	23·5 22 0 22·0	27·00 28·00 27·50	$\frac{277·5}{22·3}$ = 12·4
Ditto (later).	..	..	24·0 24·3 23·0	28·25 27·00 28·00	$\frac{277·5}{23·7}$ = 11·7
II.	17·8	145·7 gross 130·8 net	22·0 22·0 21·5	28·50 28·50 29·25	$\frac{287}{21·8}$ = 13·16

May 5, 1911.

[Rate, 10 cubic feet per hour; candle power, 12·2.]

Time.		Dist.		$\frac{D \times 10}{T}$.	Calorific Power, B.Th U.
22·5	..	25·5		11·7	{ Gross, 127·5 (134·3) calc.
22·0	..	26·5			{ Net, 117·6 (121·1) calc.
27·5	..	26·5			
23·0	..	27·0			
22·0	..	27·0			
112·0	..	132·5			
22·4	..	26·5			
		Through Benzene.			
31·0	..	29·0	..	9·36	
29·0	..	27·5	..	9·49	
28·0	..	26·5	..	9·47	Time, 28·7 sec.; def., 272 mm.
27·5	..	26·0	..	9·47	
28·0	..	27·0	..	9·65	
143·5	..	136·0			
28·7	..	27·2			
		More Benzene Added.			
28·0	..	27·5	..	9·84	Time, 27·7 sec.; def., 267·5 mm.
27·5	..	26·0	..	9·45	
55·5	..	53·5			
27·75	..	26·75			
		Through Gazene.			
34·0	..	30·0	..	7·50	
30·0	..	28·0	..	9·33	
28·0	..	26·0	..	9·29	
28·5	..	26·5	..	9·30	
120·5	..	110·5			
30·12	..	27·6			
		Through Naphtha.			
27 0	..	26·5	..	9·83	
26·0	..	25·0	..	9·63	
26·0	..	24·5	..	9 42	
25·0	..	25·0	..	10·00	

Junior Institution of Engineers.—At the meeting of the Institution to-morrow evening, at the Institution of Electrical Engineers, Victoria Embankment, a paper, entitled "Notes on Illumination by Gas and Electricity," will be read by Mr. Frank J. Hawkins (Durham Bursar, 1909), of Rugby; and on Saturday afternoon the members will visit the National Physical Laboratory at Teddington.

HIGH AND LOW PRESSURE DISTRIBUTION SCHEMES AT TYNEMOUTH.

By F. C. Willis, of North Shields.

[A Paper read before the North of England Gas Managers' Association, May 6.]

If the present period may be termed one of transition when referring to methods of carbonization of coal gas, it will, I think, be agreed that the term might be equally applied to methods of distribution. The pressures usually obtainable in main outlet pipes, due to the weight of our station-holders, were, a comparatively short time ago, looked upon as being the highest available for distribution.

With the rapid extension of our distributing systems, and the corresponding increase in the consumption of gas either for purposes of illumination, heating, or power, and, further, with the more scientific methods of its application, there has grown a demand for initial pressures that are not obtainable from our holders. This demand has created the means; and science and mechanical skill have devised many types of plant for raising the initial pressure of gas after leaving the holders. Consequently, the mechanical handling of our principal commodity is becoming more and more a matter of every-day practice. These forms of plant are varied, and so are the methods of dealing with, and controlling, the gas after it has passed into the various districts. The pressure increase may vary from a few inches water-gauge in the open type high-speed fans, to 5 lbs., 50 lbs., or even 100 lbs. per square inch in the more positive rotary blower and reciprocating piston types of compressing plant.

The purpose of this paper, as the title implies, is not to review the whole field of gas distribution, with its many complex problems and difficulties, nor yet to lay down hard-and-fast rules as to the best methods of its mechanical treatment—*i.e.*, mechanical in the sense of augmenting the gasholder pressures. One particular scheme which may give excellent results in gas company A's district may be entirely unnecessary or unsuited to gas company B. It is rather intended to put before the members of the Association two distinct and separate schemes of mechanical distribution recently adopted, and now in regular use, at Tynemouth; and with the hope that an account of our former difficulties, and a description of the methods adopted for overcoming them, may be of interest to the members, I ask for your indulgence.

At the outset, I am confronted with the query: "What is high and what is low pressure, as applied to our present-day methods of gas distribution?" While not pretending to arrive at a solution, I have made, for purposes of convenience, a distinction in the present instance, and leave the true dividing line for future discussion.

Scheme A.—High-Pressure Distribution, Boosting Section.

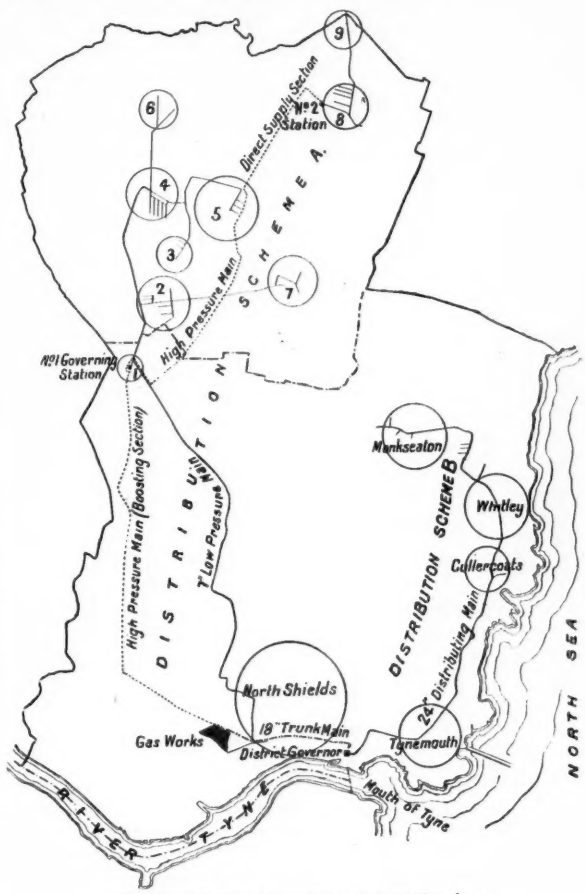
The principles involved in high-pressure distribution, whereby gas at pressures of 5 lbs. per square inch and upwards is transmitted in a state of high compression through small steel pipes for considerable distances, dumped down in bulk at prearranged points far removed from the manufacturing station, and governed at these points to any convenient pressure that may be required for the surrounding area, is calculated to have a very important influence upon the future increase and prosperity of our great industry.

The extensive area supplied by the Tynemouth Gas Company includes on the north-west side the Earsdon urban district. This area, which is the one supplied by the high-pressure scheme A, contains many scattered townships, villages, and colliery districts, varying in size from 40 to 200 houses. A number of these districts were supplied with gas prior to 1908 through a 7-inch diameter low-pressure main from town. This main, which was quite successful in maintaining the supply when first laid, gradually became inadequate as the number of consumers increased and as new districts were added to it. The serious drop in pressure at periods of heavy consumption became a matter of anxiety; and we had to immediately consider the problem of an adequate supply at peak-load with a view to retaining our consumers.

As will be readily understood, the trouble not only brought in numerous complaints and threats, but also meant a curtailed revenue. The expense entailed in replacing our existing 7-inch main by another not less than 10 inches in diameter for a distance of 6000 yards, could not be favourably considered. Even if this alteration had been carried out, there was always the possibility of a repetition of the troubles already experienced.

Our attention was drawn at the time to the remarkable developments of high-pressure distribution in the United States, so clearly described by Mr. Searle in his interesting paper read before the Institution of Gas Engineers in 1907, and also to the high-pressure work carried out by Mr. George Helps, of Nuneaton, Mr. Meunier, of Stockport, and others. It was finally decided that the best method of overcoming the shortage of supply and pressure difficulty was to boost-up, or reinforce, during periods of heavy consumption, the supply of gas through our overtaxed 7-inch main. A 4-inch diameter steel high-pressure pipe (in part 3 inches) was laid between the works and the terminus of the 7-inch main—a distance of 5870 yards measured on the pipe line. Compressing plant was then erected and coupled up at the works end; and governing plant, fixed in a suitable house, was connected at the district end of the steel pipe.

This high-pressure pipe was taken by the most direct route, along a waggon-way for the greater part, and where reinstatement charges were low. The immediate result after putting the high-pressure scheme into use was an ample supply of gas for all consumers, and regular and adequate pressures. Districts which had previously been obtaining 10-10ths, and in many cases less than 10-10ths pressure, were now obtaining a minimum of 25-10ths at peak-load. It was found, shortly after putting the high-pressure main into use, that the compressing plant was working much harder than we calculated upon, and was consequently forcing considerably more gas through the steel pipe than that required for the consumers in the Earsdon urban district.



Tynemouth Gas Company's Area of Supply,

Showing Districts served by Distribution Schemes A and B.

Note: Districts Nos. 1 to 7 served by Scheme A—Boosting Section.
Districts Nos. 8 and 9 served by Scheme A—Direct Section.

It was soon discovered that we were not only supplying this area, but other districts nearer home, through the 7-inch low-pressure main. This difficulty did not cause much inconvenience; but it was decided to reserve the compressing plant for our distant areas. We overcame the small trouble—a common one with boosting schemes of this class—by fixing a 7-inch Peebles mercurial district governor on the low-pressure main and close to the new governor-house. This governor was weighted to give a lower outlet than that for which the high-pressure regulators were set. The compressing plant is started daily at sunset, and continues to work till about midnight. During the rest of the twenty-four hours, the 7-inch main supplies our consumers, and the mercurial governor is then in action. As soon as the steel main is under pressure, the regulators automatically come into use, raise the pressure in the distributing system to the required amount for which they are adjusted, and the mercurial governor is automatically put out of action—thus shutting off the 7-inch main and preventing the return of compressed gas to town.

As illustrating the measure of success attained by our system of high-pressure distribution, a scheme of extension was immediately commenced, and low-pressure mains were carried to other neighbouring colliery villages. The table below gives particulars of the district served by our high-pressure scheme (the boosting section), and shows the number of consumers recently added.

Number of consumers at December, 1907 . . .	897
High-pressure main laid in 1908	
Number of consumers at December, 1910 . . .	1490
Increase after laying high-pressure main, per cent.	66

Although this addition has taken place in our high-pressure area, there has not been the slightest difficulty regarding pressures or deliveries. All these consumers are supplied through the one duplicate set of governing plant, and the only alteration required has been to increase from time to time the regulator outlet pressures to allow of an ample supply of gas at the extreme points of the low-pressure distribution.

The boosting plant consists of the following parts:—

1.—One Ingersoll-Rand compressor and one Milne compressor. Each compressor is of the double-acting piston type, having a maximum delivery capacity of 10,000 cubic feet per hour, against an outlet pressure of 40 lbs. per square inch. These compressors, which are steam driven, were put through a ten hours' test after erection, for delivery capacity at 40 lbs. pressure, and came out satisfactorily—particularly so in the case of the Milne plant, which averaged more than 2½ per cent. above the amount specified.

2.—A steel receiver connected to the compressor outlets, 3 ft. diameter by 10 ft. long, similar to an egg-ended boiler, and acting in the double capacity of a reservoir or storage cylinder for high-pressure gas and also that of a cushion to check the pulsations of the gas as it leaves the compressor.

3.—A steel main formed of the Mannesmann weldless type of tube, coated, covered, and fitted with the "Rigid" socket joint.

4.—A governing plant consisting of Crawford type regulators as manufactured by the Equitable (U.S.A.) Meter Company. These are arranged in duplicate sets. East set consists of one high-pressure lever type and one low-pressure dead-weight type of diaphragm governor.

The high-pressure gas is reduced in two stages, as follows: The first, or high-pressure, governor reduces down from the inlet pressure to about 3 lbs. per square inch. The second, or low-pressure, governor receives the gas at this pressure and reduces it down to the particular amount required in the district.

As previously stated, the steel main is under pressure daily from sunset to about midnight. The main is, however, used during the rest of the twenty-four hours as a low-pressure supplementary main; there being a bye-pass connection and valves from the holders arranged for this purpose. We raise and lower our high pressures very gradually, building up from holder pressure at sunset to a working pressure at the present time of 15 lbs. per square inch in the space of an hour. This pressure is maintained until 1½ hours before shutting-down the plant, and then gradually reduced to the lowest possible. The bye-pass valve is opened at the end of the boosting period, and gas is then admitted into the main direct from the holders until the following evening. The present governor outlet pressure in our district is 6 inches water-gauge during the boosting period.

Scheme A.—Direct-Supply Section.

The boosting scheme just described was not long destined to mark the termination of our high-pressure work. Two important districts on the borders of the area previously referred to, and over 5 miles from the works (measured in a straight line), claimed that they had an equal right to be served with gas as in the case of the other townships. The distance from the No. 1 governing station to the nearest house in this new area was 5700 yards; and the advisability of distributing gas for this extended distance, especially after our former experience, was not at first favourably considered.

Electricity had already arrived in the district; and there was some doubt as to whether a sufficient number of consumers could be obtained to warrant the necessary capital outlay. Further, we were of opinion that a low-pressure extension from the No. 1 governor-house would not be a success. A high-pressure extension scheme appeared to be the only feasible solution, especially as there was still an ample margin of compressing power. It was decided late last summer to extend the existing high-pressure main from a point on the inlet side of the No. 1 governing station and lead it into the new district. The total length of high-pressure main, with this extension, was 11,570 yards or over 6½ miles, measured on the pipe track. The scheme included the following.

1.—A 4-inch steel high-pressure main (5700 yards).
2.—A governing plant and house.
3.—Six-inch, 4-inch, and 3-inch low-pressure distributing mains (3600 yards in all, including 1400 yards 6 inches in diameter).
4.—Services and slot installations fitted complete.

The work commenced in October last; and all sections were carried out simultaneously by our own workmen. The 5700 yards of high-pressure main, and also the governing plant, were tested and fixed complete in less than four months; and consumers in the district were supplied with gas 4½ months after the commencement of the work. It should, of course, be remembered that the scheme was carried on in the darkest period of the year, and at maximum and minimum distances of 7½ and 3⅜ miles respectively from our works—the former distance being measured from the extreme point of distribution and along the line of supply. The actual number of consumers obtained exceeded our first estimate; and the following figures clearly indicate the popularity of gas, even where other competitors are already in the field.

Number of probable consumers (estimated from canvass)		330
Number of consumers actually obtained—		
Slot	457	
Ordinary	9	
		466
Approximate number of houses not supplied		30

Some of the consumers obtained were previously supplied by electricity; and a few of the houses not taken over were omitted on account of their being too far removed from the distributing mains. The new consumers were added day by day in batches of about 50; and in this way the compressing plant, the governing plant, and the high-pressure extension scheme generally, were gradually applied.

It has been found that the existing compressing plant is amply sufficient for the two high-pressure schemes—there being a reserve of about 30 per cent. at peak-load with both compressors working. It was, however, considered advisable to provide a duplicate plant; and there has just been erected a third compressor, made by Messrs. James Milne and Son, of Edinburgh, having a delivery capacity of 25,000 cubic feet per hour against an outlet pressure of 40 lbs. per square inch—equal to two-and-a-half times the output of either of the original compressors.

We found, as anticipated, that it was not necessary to make any radical alteration to our method of working the original high-pressure system, and we are able to satisfactorily maintain ample pressures during the periods when the compressing plant is not in use. In other words, it has been found possible to use the entire length of 4-inch steel main alternately as a high and low pressure supply. The extended portion of the 4-inch pipe between Nos. 1 and 2 governing stations, constituting the sole supply to this distant area, passes an ample quantity of gas direct from our holders during those periods when it is not under high pressure. The periods of high pressure are the same as previously mentioned, except that in mid-winter we anticipate it will probably be necessary to use our compressing plant between 6 and 8.30 a.m. during the week.

It will be readily understood that this, our second section of high-pressure distribution, places a very heavy duty upon the district governing plant. Unlike the boosting regulators at No. 1 station, which have a comparatively small valve orifice, we required governors that would not only control inlet pressures of 20 lbs. per square inch and reduce same down to 3 inches water-gauge, but they were not to restrict in any way the passage of low-pressure gas. As illustrating the duties of these governors, a few extracts from our specification are given:—

> The governors are to be preferably of the diaphragm type, and perfectly automatic in their action. They are to be designed to work satisfactorily with inlet pressures varying between a maximum of 20 lbs. per square inch and a minimum of 4 inches water-gauge; reducing the gas down to a constant outlet pressure and maintaining a perfectly steady diagram, irrespective of the variations in consumption. The outlet pressure is to be adjustable between 3 and 6 inches water-gauge. At times when the compressing plant is not in use, they will be required to automatically open full open, or the amount necessary to maintain an adequate supply of gas in the district. The governors are to be arranged in duplicate, and each set is to be of such capacity and design as will enable it to deliver gas in quantities varying between zero and a maximum of 8000 cubic feet per hour while under high inlet pressure.

The 4-inch Reynolds double district governing installation, as manufactured by the Bryan Donkin Company, of Chesterfield, during the time it has been in use has entirely met the requirements of our specification, and continues to give every satisfaction. We have not had a single complaint in the new district of lack of pressure or of excessive pressures; and the supply has been perfectly regular and constant. The governors have a total area through their valves equal to that of the 4-inch pipe, and are at present adjusted to give an outlet pressure of 4 inches water gauge. They have frequently been standing practically closed with an inlet pressure of 5 lbs. per square inch against them and not a single burner in use. The worst feature yet observed has been a momentary peak of 1½ inches above the amount for which the governors are set. This rise occurred just as the inlet pressure built up and as the valves automatically closed from the full-open position. It will be agreed that such a result is very creditable, especially when the isolated character and comparative smallness of the district are taken into consideration.

A brief description of our Reynolds governor installation, for the benefit of those members who may not be familiar with the working of it, will perhaps be of some interest here. The gas, before entering the governor, is passed through a special screen syphon fitted with a baffle-plate to intercept and throw down any small particles of dust, grit, pipe-coating, or other matter which may be carried forward by the gas under high pressure. The plant is in duplicate throughout; each set having inlet and outlet valves attached, and also a special screen casting on the inlet side, fitted with a fine wire gauze of 100 meshes to the inch, fixed in the centre of it. These screens are a further precaution to prevent any dust or grit entering and adhering to the valves of the governors.

The working part of each set consists of a 4-inch main high-pressure governor, auxiliary high and low pressure governors, needle regulating valve, pressure bowl, and all connecting piping, levers, &c. There is also a 4-inch pressure regulator and a 1 inch relief regulator fixed on the outlet side of the main governor. All governors are of the diaphragm type; being fitted with stout leather diaphragms. The main governor is fitted with double valves having a total area equal to that of the 4-inch pipe, and controlled by the outlet pressure acting on the diaphragm in the usual way. It is also weighted externally to the outlet pressure required. By

means of the auxiliary or secondary governing system, however, the main governor is kept under a further and more powerful control as follows: The high-pressure auxiliary governor is adjusted to give an outlet pressure of about 15 inches water-gauge, and the low-pressure governor is regulated to reduce this down to the pressure required on town (4 inches water-gauge in our case). The flow of the gas between the two governors is throttled by means of a needle regulating valve fixed on the line of connecting pipe. The auxiliary pressure bowl is coupled up to the intermediate piping between these governors, and is thereby filled with gas at the same pressure as that on the outlet side of the needle valve and the inlet side of the low-pressure governor. By means of spindles, levers, and links, the diaphragm and disc of the pressure bowl resolve all changes of pressure into movements of powerful control upon the valves of the main governor of the plant.

As illustrating this feature of pressure control, assume a decrease in the consumption by means of which the main governor tends to deliver more gas than is required for consumption. The outlet pressure tends to rise, and the low-pressure auxiliary governor gradually closes. This causes a banking-up of pressure in the pipes behind same, which is immediately communicated to the pressure bowl. The diaphragm of the bowl rises and exerts a lifting force through the system of levers, &c., upon the main governor valves, tending to close them—thus checking the flow of gas through the plant. Again, assuming a tendency of the outlet pressure to fall owing to increasing consumption. This drop in pressure causes the low-pressure auxiliary governor to open, thereby immediately relieving the pressure in the auxiliary piping and bowl, owing to the restricted flow through the needle valve. As a natural result, the auxiliary lifting force upon the main governor valves is reduced, thereby allowing the governor to come into action and so maintain the outlet pressure. This method of control is carried on automatically to suit all variations in pressure or consumption.

To give some idea of the closing power of the main governor valves through the medium of the auxiliary system alone, it may be stated that, with the area of the bowl disc (approximately 10½ inches diameter) and lever power (6 to 1), a pressure difference of 2 inches water-gauge in the bowl—*i.e.*, 2 inches above that of the outlet pressure—would exercise a lifting force upon the valve spindle of approximately 37½ lbs. It will readily be seen that there is thus a powerful control over excessive outlet pressures. The pressure regulators are fitted on the outlet side of the main governors as a further check upon the outlet pressure. All main valves of the governors are formed in two parts, with a stout leather disc sandwiched between. The latter forms the bearing surface upon the machined valve-seats. The 6-inch low-pressure outlet and 4-inch high-pressure inlet mains are connected up outside the governor-house, and are fitted with main inlet, outlet, and bye-pass valves.

Each set of governors was put through a series of tests at our works; being temporarily connected up for the purpose between the gas-compressor outlets and works exhauster inlet. They came out of this severe form of test to our entire satisfaction, although the fluctuations of vacuum in the exhauster inlet pipe were a disturbing factor.

High-Pressure Main Joints and Fittings.

All joints, except those at the syphons, gate-valves, &c., are of the Mannesmann "Rigid" socket type, having an inner socket 6 inches and an outer socket 1½ inches long. While the usual practice appears to be to drive all spigot ends hard up into the inner socket, we took the precaution of allowing ¾ inch clearance at the back of the inner sleeve for possible expansion, which is almost certain to occur in long, straight leads of pipe. The joints of all steel tubes are made with cast lead throughout. While not in any way wishing to adversely criticize lead wool—for we are convinced that excellent work has been, and is being, done with this form of jointing material—we believe that it would have been difficult to have obtained a high-pressure joint superior to our own.

The jute cloth was unwrapped at each socket end, and all spigots and sockets held over a slow fire until the coated surface for the depth of the joint was entirely removed. An asbestos compo. jointing clip, having the inner edge deeply hollowed out, was used to form the joint. Thus, after running, the lead was in intimate contact with the steel—there being no coating left between to impair the unity of the two. Each joint was left with a heavy fillet for setting-up and caulking; this work being carried out by skilled and reliable workmen. After satisfactory tests, the joints were thoroughly coated externally, and then covered and bound with jute cloth. Gate-valves were arranged at distances of half-a-mile apart, there being also a flanged T at each of these points, with a 2-inch diameter flanged branch for test purposes. Heavy cast-iron flanged and ribbed syphons were fixed where required. All 4-inch flanges were machined the full width, and each had six holes drilled for ¾-inch bolts.

High-Pressure Main Test.

The first section of high-pressure main was tested throughout its entire length by air pumped in at a pressure of 65 lbs. per square inch by West's air compressors at our works. This excellent method of testing could not, of course, be applied in the second section of the main, and it was not considered advisable to test direct with gas forced in by the gas compressing plant. It was finally decided to keep the whole extension isolated until completed. The "Milne" portable high-pressure main test, fitted with two 4-inch hand pumps and arranged in an amended form, was used for testing the second portion of the main. The main was sectionized by means of the gate-valves previously mentioned, and tested in stretches about half a mile in length.

The test pump was connected to the branch T, and for intermediate lengths a rubber stopper, with dial gauge attached, was inserted in the end of pipe. Four men working at the pump levers raised the pressure to 30 lbs. per square inch; and under this pressure each joint was carefully tested by soaped water, brush, and mirror in the usual way. For the half-mile sections the stopper was not required; this being replaced by the gate-valve. As each section was completed, the test-pump was taken forward and refixed at the next branch immediately beyond the gate-valve; the branch from which it was disconnected being made perfectly tight by means of a blank flange. In this way, the whole main was tested in stretches of about half-a-mile. Every joint was tested under the supervision of the engineer or general foreman, and nothing was taken for granted.

After completion, gas was admitted into the high-pressure main, and the pressure was raised to 15 lbs. per square inch. A valve at the No. 1 governing station which divided the second section from the first, was then closed. The new section remained under the pressure mentioned for a period of 15 hours; and at the end of this time the pressure was found to be standing at 7 lbs. per square inch. When the length of test is considered, along with the fact that the gas under pressure had a volume of only about 1500 cubic feet and was enclosed by a total pipe surface of about 17,500 square feet, this test will no doubt be regarded as a fairly satisfactory one.

Testing of Low-Pressure Distributing Mains, &c.

It was not possible, as is usually the case, to test the low-pressure mains by gas as they were laid. We, however, tested these pipes by air pressure in a manner similar to that adopted for the testing of the high-pressure main, except that the test pressure was 5 lbs. per square inch instead of 30 lbs. The services and service cocks were included in this test, but nothing beyond the latter. The house piping and fittings were not tested until gas was turned on; and there were very few cases of internal leakage reported.

Syphonage and Temperatures.

Our experience shows that, for distances beyond a quarter of a mile from the compressing plant, there is very little water or oil found in the syphons. But nearer the works we obtain water and oil syphonage in varying quantities, though there is not much oil at our working pressure of 15 lbs. per square inch.

The oil is inflammable, strongly odourous, and is fairly light. At the present period of the year, we get an average of about 8 to 10 oz. weekly out of the receiver and the first syphon. The water condensed at the receiver and first two syphons averages about 10 gallons. Thus on the present total weekly deliveries, the compressed gas throws down approximately 0·04 oz. of oil and 0·04 gallon of water per 1000 cubic feet delivered. The temperature of compression for our working pressure of 15 lbs. per square inches averages 118° Fahr.

Oscillation and Vibration of Pressures.

There is a natural tendency for the reciprocating type of compressor, such as are used for our high-pressure schemes, to cause slight vibrations of the inlet and outlet pressure. This is satisfactorily overcome on the outlet side by the steel receiver, and cannot in the slightest degree be traced 100 yards beyond. On the inlet side, the suction pipes are connected to the No. 1 gasholder, which is almost entirely used for the purpose of supplying compressors; and thus the slight inlet vibration is entirely lost. No doubt many of the efficient forms of anti-fluctuators now on the market would answer the same purpose.

Relief Valves, Safety Seals, &c.

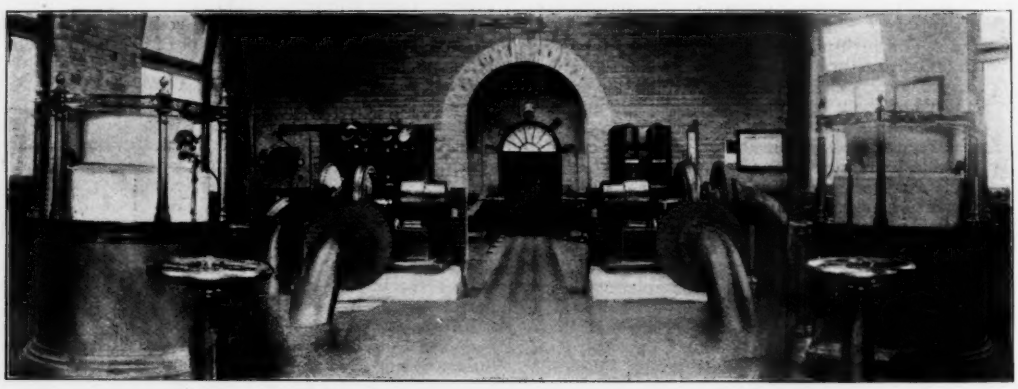
Each compressor is fitted with a high-pressure relief valve of the spring-control enclosed type, connected between the inlet and the outlet pipes, and set to blow-off at a pressure about 4 lbs. above that at which the plant usually works.

The new compressor recently supplied by Messrs. James Milne and Son is also fitted with a gas-governing device whereby the outlet pressure, acting on the underside of a steel corrugated diaphragm governor, controls through a system of levers a secondary sleeve on the spindle of the engine governor. This gas control is adjusted to a certain outlet pressure; and should the compressor deliver too hard for the consumption, and thereby build-up outlet pressure, then the high-pressure gas, acting on the underside of the diaphragm, raises it. This movement, transmitted through the system of levers, closes to the required amount the steam throttle-valve, and thus reduces the speed of the compressor.

The outlet of each governing station is fitted with a mercurial safety-seal, somewhat similar to the "Reynolds" type. These seals are of ample size, and are set to blow-off at a pressure of 12 inches water-gauge, and so prevent all possibility of excessive pressures in the district.

Record of Pressures.

There are weekly records of inlet and outlet pressure constantly taken at the works and at each governing station; and the pressure registers from the various instruments are brought in for careful inspection each week.



General View of the Fan House and Engine House.

Oiling Diaphragms.

There has not yet been much reason to suspect the compressed gas of absorbing oil out of the governor diaphragms, or of causing any other inconvenience beyond the point of expansion. We, however, take the precaution of oiling all governor diaphragms once a month with best almond oil, to keep them soft and pliable. We have not yet fitted any high-pressure service installations; but a row of about forty houses on the line of pipe have been supplied through a small Crawford regulator for about 2½ years; the regulator being fixed in an underground chamber. This supply, nearer the compressing plant than any other, has been successfully maintained.

Useful Data.

The delivery through pipes under high-pressure conditions is a subject of considerable interest; and while our particular conditions of working do not make it possible to furnish a large amount of data, we give the following tables, which represent figures taken at various times and periods—the pressures being recorded by Bristol recorders adjusted from one standard.

Table of Rates of Delivery of Gas through High-Pressure Main.

Date.	Time.	Pressures in Pounds per Square Inch. Works. A.	B.	Governing Station, No. 1. C.	Governing Station, No. 2. D.	Rate of Delivery in Cubic Feet per Hour. Actual Delivery. A to C.	Estimated (by Proportion of Consumers) C to D.
	p.m.						
Dec. 30, 1908	..	14·0	..	4·5	..	11,625	..
Feb. 5, 1909	..	15·0	..	11·0	..	9,375	..
Dec. 31, 1909	..	16·0	..	9·0	..	11,625	..
April 26, 1910.	7.45	10·0	10·0	8·0	..	5,800	..
,, ,, ,,	8.0	18·0	18·0	11·0	..	12,500	..
,, ,, ,,	8.15	18·0	18·0	15·0	..	11,600	..
,, ,, ,,	8.30	18·0	18·0	14·0	..	12,500	..
,, ,, ,,	8.45	18·0	18·0	13·0	..	12,600	..
April 21, 1911.	8.0	14·0	13·5	6·3	7·0	10,000	2500
,, ,, ,,	8.15	14·0	13·5	6·0	6·7	15,000	3750
,, ,, ,,	8.30	14·0	13·5	5·0	5·5	10,000	2500
,, ,, ,,	8.45	14·0	13·5	4·0	5·0	12,480	3120
,, ,, ,,	9.00	13·75	13·0	2·0	4·8	12,480	3120
,, ,, ,,	9.15	13·75	13·0	1·8	4·6	12,480	3120
,, ,, ,,	9.30	13·75	12·5	1·8	4·5	12,480	3120
,, ,, ,,	9.45	14·00	13·0	1·8	4·6	10,000	2500
,, ,, ,,	10.00	14·50	13·0	2·0	5·0	12,480	3120
April 28, 1911.	8.0	14·00	13·5	11·0	10·0	7,500	1875
,, ,, ,,	8.15	16·00	16·0	11·5	11·0	12,500	3125
,, ,, ,,	8 30	15·70	15·5	10·0	9·5	10,000	2500
,, ,, ,,	8.45	15·70	15·0	9·0	9·0	10,000	2500
,, ,, ,,	9.00	15·00	14·5	8·0	8·0	12,500	3125
,, ,, ,,	9.15	15·00	14·5	7·5	7·5	10,000	2500
,, ,, ,,	9.30	14·5	14·0	7·0	7·0	12,500	3125
,, ,, ,,	9.45	14·3	14·0	6·3	6·2	12,500	3125
,, ,, ,,	10.0	15·0	14·5	8·0	6·5	12,500	3125

Notes on Delivery Tables.

{ Length of main A to B . . . . . = 1870 yards.
{ Diameter ,, A to B . . . . . = 4 inches.
{ Length ,, B to C . . . . . = 4000 yards.
{ Diameter ,, B to C . . . . . = 3 inches.
{ Length ,, C to D . . . . . = 5700 yards.
{ Diameter ,, C to D . . . . . = 4 inches.

The readings taken on April 21, 1911, appear to indicate that pressures at governing station No. 1 are less than those at No. 2 station, which is 5700 yards further away from compressing plant. The readings in column C for this date, however, were taken close to the regulator inlets, and beyond the junction of the extension main; and the drop is apparently caused by the heavy drag between this point and the regulators at No. 1 station. The corresponding readings in column C for April 28, 1911, were taken at a point a few yards in advance of the junction of the new and existing mains, nearer the works, and, therefore, before the dividing point of the two streams of gas.

The rate of deliveries through extension main to station No. 2 (see columns C to D) are estimated upon the number of consumers; there being no meter on this main to give actual figures.

The effect of compression upon the illuminating and calorific values of coal gas is naturally a subject of intense interest and importance. While we have obtained certain information in connection with our high-pressure work, it is necessary to point out that there are many factors to be taken into consideration, and many difficulties attaching to the work of carrying out these tests in a satisfactory manner. We feel that, in the limited time at our disposal, and the extremely small number of tests made, the figures given below should not be taken as representing ultimate results in this connection. It is our intention to further study this subject; and at some future time we hope to place on record fuller and more complete information.

The results of the illuminating value tabulated below were obtained by means of a 100-inch standard bar, bunsen disc, and No. 2 "Metropolitan" argand, the standard illuminant used being a Simmance 10-candle pentane lamp. The calorific values were obtained by the Simmance-Abady calorimeter. Each relative set of tests was obtained by the same apparatus, and from the same stock of gas. The results in the B columns were obtained beyond the point of compression at the No. 2 governing station, and more than 6½ miles away from the works testing station; the results from the latter point being tabulated in the A columns.

Date.	Illuminating Values.			Calorific Values (Net).		
1911.	A.	B.	Decrease.	A.	B.	Decrease.
—	Works.	Holywell.	Per Cent.	Works.	Holywell.	Per Cent.
April 21.	Candles. 15·83	Candles. 14·75	6·82	Calories. 139·13	Calories. 130·80	5·90
April 28.	15·57	14·47	7·06	134·74	128·10	4·93

Already much useful high-pressure distribution work is being done in this country; and from our experience and that of others, it can confidently be asserted that gas, under these new conditions, can be distributed over considerable distances with an equal amount of success as obtains in that of water or electricity. Urban district areas similar to our own containing townships and villages which were previously considered by neighbouring gas companies as being entirely inaccessible, not only on account of expense, but also owing to the difficulty of maintaining adequate pressures, can now, without doubt, be numbered among the consumers of gas and successfully supplied.

Scheme B—Low-Pressure Distribution.

The benefits derived from the open type, high-speed fans, which can be fitted in convenient positions and coupled-up to our gasholder outlets, are very considerable. Not only do they allow of every available foot of storage capacity being usefully applied in, cases where, before their inception, the top lifts of our holders were of little value for pressure purposes, but they also tend to lead to the centralization of our storage stations, and in some cases make it possible to discard distant holders which before were an absolute necessity. Further, by their use we are enabled to retain and satisfactorily use, trunk mains too small for the required deliveries under ordinary holder pressures during periods of heavy consumption. The area supplied by the Tynemouth Gas Company, besides including areas such as are served by the high-pressure schemes just described, is divided into two larger districts: (1) The town of North Shields, in the immediate neighbourhood of the works; (2), the distant district including the well-known seaside resorts of Tynemouth, Cullercoats, Whitley Bay, and Monkseaton. The former district is supplied direct through a 24-inch main, and the latter through an 18-inch main. The gas consumption in each district is at the present time approximately equal. The second or distant district has in recent years grown at a very rapid rate, and conditions of supply amply sufficient in the past have become quite inadequate in recent years.

[The author then reproduced, in very slightly modified form, the article by Mr. William Hardie, on "Pressure Raising Plant at Tynemouth," which appeared in the "Journal" for March 1 last year, p. 564, supplementing it with a few further particulars as to the working of the plant.]

BACTERIAL PURIFICATION OF AMMONIA-RECOVERY LIQUOR.

At the Meeting of the Manchester Section of the Society of Chemical Industry early last December, three papers on the above-named subject were submitted. The first, in which the matter was dealt with generally, was by Dr. Gilbert J. Fowler and Messrs. E. Ardern and W. T. Lockett; the second, dealing with experiments carried out at the Manchester Gas-Works, was by Dr. Fowler and Mr. A. L. Holton; and the third, giving particulars of experiments made at the Bradford Gas-Works, was by Dr. Fowler and Mr. S. W. Shepherd. Mr. Holton, it may be mentioned, is the President-Elect of the Manchester and District Junior Gas Association, and Mr. Shepherd was the Past-President for 1909-10 of the Yorkshire Junior Association. The three communications, with a report of the remarks made upon them, have since been published in full in the Society's "Journal," from which the following particulars are reproduced.

MESSRS. FOWLER, ARDERN, AND LOCKETT'S PAPER.

Many years ago, experiments on the purification of Manchester sewage, which contained rather more than 0·5 per cent. of ammonia-recovery liquor, showed that it was possible to purify the liquor when mixed in this proportion with sewage. Further, an accidental discharge into the sewer of an abnormal volume of waste liquor from spent oxide washing, which contains a fair proportion of thiocyanates, occurred on Dec. 2, 1899. But it was found that the filters dealing with this sewage were capable of reducing the oxygen absorption from permanganate from 34·3 to 3·6 parts per 100,000. Frankland and Silvester * have since shown that sewage containing 9 per cent. of ammonia-recovery liquor can be satisfactorily purified on bacterial filters.

As a very large proportion of the oxidizable matter contained in this waste liquor consists of tar acids and thiocyanates, experiments were first made in 1899 on the oxidation of pure solutions of phenol and ammonium thiocyanate. The filters consisted of glass tubes, 30 inches long and 2 inches in diameter, filled with mature filtering medium taken from a primary contact bed dealing with Manchester sewage. The experiments showed that a solution of ammonium thiocyanate was capable of oxidation on bacterial filters, with the formation of nitrate and sulphate, and also that dilute solutions of phenol were readily oxidized.

Since the date of these experiments, considerable attention has been devoted to the examination of ammonia-recovery liquor. Its composition varies with the concentration—*i.e.*, with the degree to which the ammonia is removed in the distillation. Frankland and Silvester, in the paper previously referred to, give the following analyses:—

—	Parts per 100,000.		
	Average.	Maximum.	Minimum.
Phenol	140·1	172·3	108·0
Thiocyanate (as CNS)	153·8	171·7	143·0
Thiosulphate (as S)	46·8	52·5	41·1
Oxygen absorption, four hours	499·4	564·0	401·2
,, ,, three minutes	333·9	391·7	300·0
Free and saline ammonia	12·8	17·2	9·6
Ammonia evolved by alkaline permanganate	14·2	20·8	11·4

Skirrow gives the following analysis, together with the proportion of the total oxygen absorption due to the various constituents:—

—		Parts per 100,000.	
		Oxygen Absorption Three Minutes.	Per Cent. of Oxygen Absorption.
Tar acids	212	284·7	52·0
Thiocyanates (as CNS)	225	182·7	33·3
Thiosulphate (as S)	64	53·0	9·7
Ferrocyanide (as Na salt)	28	0·5	0·1
Other bodies (by difference)	..	26·9	4·9
Total		547·8	100·0

In 1908, Calmette stated that a solution of potassium thiocyanate entirely escaped oxidation when treated on aerobic bacterial filters. It should be mentioned, however, that his filters were matured with arable soil extracts only, and consequently must be looked upon as purely nitrifying filters. Experiments referred to later will indicate that under such circumstances oxidation would hardly be expected. Calmette's statement, however, drew the attention of the authors again to the question of the oxidation of ammonia-recovery liquor; and the earlier experiments quoted were repeated in 1908, and again in greater detail during the present year [1910].

* See "JOURNAL," Vol. XCVIII., p. 92.

The experiments in 1908 were conducted with similar filters to those used in 1899, with the exception that the filtering medium was taken from a mature secondary filter instead of from a primary one. Solutions of potassium and ammonium thiocyanates only were dealt with; and though the action proceeded considerably slower than in the earlier experiments, it was found possible, by allowing numerous contacts with the filtering medium, to eventually completely decompose both potassium and ammonium thiocyanate with formation of nitrate and sulphate. Experiments conducted during the present year have been carried out in greater detail than the earlier ones alluded to. [The authors gave a description of the filters and the methods of working them.]

METHODS OF ANALYSIS.

Thiocyanate.—Determined by the addition of ferric chloride to minimum quantities of the solutions and comparison of colouration produced with that obtained with varying quantities (0·1 c.c. to 1·0 c.c.) of a standard solution of ammonium thiocyanate containing 1 gramme of the pure salt per litre.

Thiocyanate in Presence of Phenol.—In the filtration experiments on mixtures of thiocyanate and phenol, it was found possible by using minimum quantities of solution to determine the thiocyanate directly as above. Experiments showed that the phenol present was insufficient to affect the coloration produced.

Phenol.—The general method adopted was that described by Skirrow in a paper on the "Determination of Phenols in Gas Liquors."* In the case of filtrates containing phenol alone the determinations were made direct, by the addition of the required amount of potash, formation of tri-iodo-phenol, and titration of excess of iodine with thiosulphate.

Phenol in Presence of Nitrite.—Whenever nitrite appeared in the filtrates, it was found necessary first of all to decompose it by the addition of urea and sulphuric acid. Experiments have shown that urea does not interfere with the subsequent reaction.

Phenol in Presence of Thiocyanate.—The method adopted in this case is described in the paper previously quoted, and consists essentially of the separation of phenol from thiocyanate by a series of distillations and determinations of phenols in the distillates.

OXIDATION OF THIOCYANATES.

(A) *Comparison of Potassium and Ammonium Thiocyanate.*—The first point investigated was the comparison of the oxidation of ammonium and potassium thiocyanates. Although the results of the first experiments were rather favourable to the potassium salt, as the result of a number of determinations it may be concluded that there is no material difference between the rates of oxidation of the two salts.

(B) *Course of Reaction.*—As a result of the previous experiment, it was decided to continue the investigations with potassium thiocyanate, so that the oxidation of the CNS radicle could be more readily followed.

Numerous experiments were therefore carried out on the filtration of solutions of potassium thiocyanate, and the following determinations made at intervals during the course of the experiment—viz., oxygen absorption from permanganate, thiocyanate, nitrogen and its various compounds, and sulphate. In order to eliminate any error due to oxidation changes in the filtering medium itself, a control filter was worked with tap water, side by side with the one dealing with thiocyanate. [The results of some typical experiments are tabulated.] Assuming that the oxidation changes in the medium of the working filter are identical with those of the blank filter receiving water, the results show that practically 50 per cent. of the nitrogen contained originally in the thiocyanate was recovered as ammonia and nitrate, and rather more than 70 per cent. of the sulphur originally present was found as sulphate in the final filtrate.

(C) *Effect of the Addition of Nitrate.*—(1) In the form of potassium nitrate; (2) in the form of a highly-purified sewage effluent containing a large proportion of oxidized nitrogen. The object of this experiment was to determine how far denitrification changes were concerned with the purification process; and in Table I. are given the mean of results of three experiments. It will be seen that the addition of nitrate appears slightly to retard rather than facilitate the reaction.

TABLE I.—*Filtration of Potassium Thiocyanate and Nitrate.*

[Results in parts per 100,000.]

—	Thiocyanate *plus* Nitrate.			Thiocyanate Alone.	
	Four Hours' Oxygen Absorption.	Thiocyanate as CNS.	Nitric N.	Four Hours' Oxygen Absorption.	Thiocyanate as CNS.
Original solution	7·93	9·3	11·5	8·20	9·5
Filtrate after 2 contacts	6·07	6·7	..	6·17	6·9
,, ,, 4 ,,	4·55	4·9	..	4·25	4·7
,, ,, 6 ,,	3·25	3·4	..	2·70	2·8
,, ,, 8 ,,	2·30	2·1	..	1·53	1·4
,, ,, 9 ,,	1·75	1·6	..	0·79	0·7

The results of experiments on the addition of nitrate in the form of a highly purified sewage effluent are given in Table II.

* See "JOURNAL," Vol. CI., p. 357.

TABLE II.—*Filtration of Potassium Thiocyanate and Highly-Purified Sewage Effluent.*

[Results in parts per 100,000.]

—	Thiocyanate and Effluent.			
	Four Hours Oxygen Absorption.	Thiocyanate as CNS.	Ammoniacal N.	Nitrous and Nitric N.
Original solution	8·00	9·2	0·23	1·92
Filtrate after 4 contacts . .	4·60	4·5	0·59	2·47
,, ,, 8 ,, . .	2·46	2·2	0·59	3·05
,, ,, 9 ,, . .	1·83	..	0·74	3 26
,, ,, 10 ,, . .	1·46	1·0	..	3·46

—	Thiocyanate Alone.			
	Four Hours' Oxygen Absorption.	Thiocyanate as CNS.	Ammoniacal N.	Nitrous and Nitric N.
Original solution	8·30	9·2	0·13	0·31
Filtrate after 4 contacts . .	4·20	4·2	0·60	..
,, ,, 8 ,, . .	1·77	1·4	0·61	1·17
,, ,, 9 ,, . .	1·14	..	0·67	1·17
,, ,, 10 ,, . .	0·46	trace	..	1·23

These results show that the final oxidation change is obviously one of nitrification. The fact that the activity of the filter is not increased by the addition of sewage effluent is probably due to there being already suitable conditions for the adequate nitrification of the thiocyanate, as evidenced by the formation of nitrates in the filter receiving thiocyanate alone. The constant increase of nitrate in the filtrates obviously gives no indication of denitrification.

(D) *Filtration of Stronger Solutions of KCNS.*—The later experiments were confined to the oxidation of increased strengths of potassium thiocyanate solution, of which the following typical examples may be given.

—	Four Hours' Oxygen Absorption.	Ammoniacal Nitrogen.	Nitrous and Nitric Nitrogen.	Thiocyanate as CNS.
Original solution	13·20	0·14	0·38	15·3
Filtrate after 4 contacts . .	7·80	0·63	0·77	9·8
,, ,, 8 ,, . .	4·71	1·06	1·10	4·5
,, ,, 12 ,, . .	2·29	1·32	1·48	1·5
,, ,, 16 ,, . .	0·97	0·99	1·91	nil
Original solution	17·40	0·22	0·49	18·7
Filtrate after 4 contacts . .	10·30	1·04	1·04	11·2
,, ,, 8 ,, . .	6·70	1·59	1·15	6·1
,, ,, 12 ,, . .	1·66	1·86	..	1·0
,, ,, 14 ,, . .	0·46	2·35	1·76	trace

It will be seen that the results are similar to those obtained with the weaker solutions of thiocyanate; the stronger solutions, of course, requiring further contacts with the filtering medium, to effect complete oxidation.

It may be mentioned that special observations with the stronger solutions of thiocyanate have shown that while nitrites are always found in the filtrate, by far the greater proportion of the oxidized nitrogen appears as nitrate. Bacterial examination of the filtrates from the thiocyanate solutions of the greatest strength used showed apparently no inhibiting effect.

OXIDATION OF PHENOL.

(A) *Filtration of Phenol Solution.*—A large number of experiments were carried out on the filtration of varying strengths of phenol solution; and typical results obtained are tabulated. They show that solutions of phenol containing from 10 to 15 parts of phenol per 100,000 are rapidly oxidized on bacterial filters; three contacts with the filtering medium being sufficient to complete the oxidation of the phenol. They also show that it is possible to oxidize solutions containing as much as 68 parts of phenol per 100,000, though in this case numerous contacts with the filtering medium are required. Some of the experiments clearly indicated the beneficial effect of a prolonged recuperative period on the activity of the filter.

(B) *Course of Reaction.*—Though no attempt has been made to isolate intermediate products, it is most probable that the final oxidation products are carbonic acid and water. Examinations of the final filtrate after the complete oxidation of phenol showed only small quantities of carbonic acid and bicarbonate—in fact, the amount found was only equivalent to 1·9 per cent. of the original carbon present. It must, therefore, be concluded that the carbonic acid formed is either absorbed by the filtering medium or evolved during the oxidation periods between the fillings. The increase in total solids in the final filtrate from the filter dealing with the phenol solution, over the amount in the filtrate from the control filter, was found to be only 2·2 parts per 100,000. This result corroborates the conclusion that the final oxidation products of phenol are carbonic acid and water, inasmuch as the bicarbonate present is sufficient to account for the increase of the solids in solution.

(C) *Effect of the Addition of Nitrate.*—(1) In the form of potassium nitrate; (2) in the form of a highly-purified sewage effluent containing a large proportion of oxidized nitrogen. The results of typical experiments are given in Tables III. and IV.

TABLE III.—*Filtration of Phenol and Nitrate.*

[Results in parts per 100,000.]

—	Filter A—Phenol with KNO_3.			
	Four Hours' Oxygen Absorption.	Phenol.	Nitrous Nitrogen.	Nitric Nitrogen.
Original solution	61·33	32·0	nil	10·29
Filtrate after 3 contacts . .	13·60	6·6	0·06	8·65
,, ,, 4 ,, . .	4·74	2·7	0·06	..
,, ,, 5 ,, . .	0·60	nil	0·05	8·23

—	Filter B—Phenol Alone.			
	Four Hours' Oxygen Absorption.	Phenol.	Nitrous Nitrogen.	Nitric Nitrogen.
Original solution	61·33	31·0	..	..
Filtrate after 3 contacts . .	28·60	15·7	..	..
,, ,, 4 ,, . .	21·00	12·6	..	..
,, ,, 5 ,, . .	14·10	7·9	..	..

Note.—In order to obviate any possible error due to difference in activity of the two filters, nitrate was then added to the control filter. The results from the latter at once improved, and finally the control became as efficient as the one originally receiving nitrate, as is seen by following figures.

—	Filter A—Phenol with KNO_3.			
Original solution	58·67	29·1	0·01	10·21
Filtrate after 1 contact. . .	37·60	17·9	0·01	..
,, ,, 2 contacts . .	22·40	10·4	0·11	8·63
,, ,, 3 ,, . .	..	5·0	0·12	..
,, ,, 4 ,, . .	2·43	1·7	..	8·23
,, ,, 5 ,, . .	0·49	..	..	..

—	Filter B—Phenol with KNO_3.			
Original solution	58·67	30·7	trace	10·54
Filtrate after 1 contact. . .	38·40	19·0	0·06	..
,, ,, 2 contacts . .	21·20	10·7	0·09	8·65
,, ,, 3 ,, . .	10·80	4·5	0·19	..
,, ,, 4 ,, . .	2·00	1·7	..	7·90
,, ,, 5 ,, . .	0·46	..	..	..

TABLE IV.—*Filtration of Phenol and Highly-Purified Effluent.*

—	Phenol and Nitrate with Sewage Effluent.			
	Four Hours' Oxygen Absorption.	Phenol.	Nitrous Nitrogen.	Nitric Nitrogen.
Original solution	70·86	34·0	0·01	2·88
Filtrate after 1 contact. . .	45·60	22·0	0 22	..
,, ,, 2 contacts . .	27·60	13·5	0·25	2·30
,, ,, 3 ,, . .	15·70	6·9	0·25	..
,, ,, 4 ,, . .	5·31	2·2	0·16	2·07
,, ,, 5 ,, . .	1·03	0·2	0·20	1·73

—	Phenol and Nitrate.			
	Four Hours' Oxygen Absorption.	Phenol.	Nitrous Nitrogen.	Nitric Nitrogen.
Original solution	72·00	34·2	0·01	2·30
Filtrate after 1 contact. . .	43·60	22·3	0·13	..
,, ,, 2 contacts . .	24·60	12·2	0·13	2·07
,, ,, 3 ,, . .	13·10	5·0	0·16	..
,, ,, 4 ,, . .	3·31	1 3	0·16	1·38
,, ,, 5 ,, . .	0·74	nil	0·13	1·44

It will be seen that both in the case of the addition of potassium nitrate alone and of nitrate with a sewage effluent, the oxidation of phenol was somewhat facilitated. In each case an actual loss of nitrate is to be noted—in fact, in the first set of experiments, with sewage effluent alone, the whole of the nitrate was reduced; and consequently in the later experiments, one of which is given above, a further quantity of nitrate was added in order to ensure excess. This diminution of nitrate with the production of nitrite indicates that, in the conditions of the above experiment, the oxidation change was due to some extent to denitrification. The earlier

filtration experiments showed that the oxidation could proceed in the absence of nitrates; and consequently it would appear that denitrification is not an essential factor in the process.

(D) *Effect of Addition of KHO to the Phenol Solution.*—It was thought of interest to determine if the addition of caustic potash to the phenol before filtration would affect the action in any way. Potash was added to the original solution until a reaction was given with phenolphthalein, and again, after each contact with the filtering medium, a slight excess of potash was added. The results show that the addition of potash has apparently no effect on the reaction.

Oxidation of Solutions Containing Both Thiocyanate and Phenol.

Filtration experiments with solutions of thiocyanate and phenol, in proportion to their oxygen absorption from permanganate and in approximately equal parts by weight, have confirmed the results of the experiments previously quoted. In every case it was found that phenol is more rapidly oxidized than thiocyanate.

Bacteriological Investigation.

The bacterial content of the filtrates from the various filters was determined from time to time. In the case of the filters dealing with thiocyanate, a variety of organisms was generally found; while in the case of the filtrates from the filters dealing with phenol solution, only two or three types of organisms appeared. Thus in the case of the phenol a definite selective action was clearly established. It therefore became of interest to investigate the question from the point of view of bacterial action.

In the first case, a filtrate from one of the filters dealing with phenol solution with added nitrate, which still contained a considerable amount of unoxidized phenol, was placed in a bottle, and aerated continuously by means of a suction-pump. A control experiment was made by similarly aerating a sterile solution containing as nearly as possible the same quantity of phenol, nitrate, and nitrite as in the filtrate. The air passing through the solutions was drawn first through a cotton-wool plug and the control solution, and afterwards through the filtrate. By this means, any change in phenol solutions possibly due to air infection would be readily detected by a change in the phenol content of the control. The results of the experiment are given in Table V., from which it will be seen that the oxidation of phenol in the filtrate was gradual, and that complete oxidation took place in 19 days, whereas the control experiment showed practically no change in phenol content after 53 days' aeration.

Table V.—*Aeration of Filtrate Containing Phenol.*

—	Filtrate.			
	Four Hours' Oxygen Absorption.	Phenol.	Nitrous Nitrogen.	Nitric Nitrogen.
At commencement	19·60	9·8	0·07	10·29
After aerating 1 day	18·40	..	..	..
,, ,, 2 days	16·60	8·2	0·07	..
,, ,, 6 days	11·30	5·5	0·05	..
,, ,, 9 days	8·10	3·9	0 05	..
,, ,, 16 days	2·06	..	0·05	..
,, ,, 19 days	0·80	0·2	..	8·91
,, ,, 53 days	..	..	..	..

—	Control.			
	Four Hours' Oxygen Absorption.	Phenol.	Nitrous Nitrogen.	Nitric Nitrogen.
At commencement	19·60	9·0	0·05	8·65
After aerating 1 day	..	..	..	..
,, ,, 2 days	..	..	..	..
,, ,, 6 days	..	..	..	..
,, ,, 9 days	18·80	..	0·03	..
,, ,, 16 days	..	..	..	..
,, ,, 19 days	18·20	9·4	0·03	..
,, ,, 53 days	17·20	..	..	..

The filtrate was examined bacterially at the commencement and towards the end of the experiment. The bacterial content was practically confined to two species of organism—viz., *B. liquefaciens fluorescens*, and a chromogenic organism which was practically non-liquefying. There was a decrease in the number of organisms present in the filtrate as the experiment continued.

The experiment showed conclusively that it was possible by bacterial action to oxidize solutions of phenol; and it led to investigations on the action of organisms in pure culture on phenol solutions. The organisms present in the above filtrate were isolated, and solutions of phenol inoculated with the cultures obtained. The results of this investigation were communicated to the Royal Society on Nov. 17 last; and the conclusion was that a specific organism closely resembling *B. Helvolus* (Zimmermann) is capable of completely oxidizing phenol in dilute solution.

The strongly aerobic character of the organism is illustrated by an experiment in which a similar filtrate to the one used in the experiment previously described was incubated in absence of air. No change in phenol content occurred even after fourteen days; while even after eight months' incubation a large proportion of the phenol originally present was unaffected.

Similar investigations are in progress in regard to the bacterial oxidation of thiocyanate of potassium. The results so far obtained indicate that the oxidation of thiocyanate is probably due to two or more organisms acting in symbiosis.

Summary and Conclusions.

The foregoing investigations have established—

1.—That solutions of thiocyanate and phenol can be oxidized on bacterial filters.
2.—That no essential difference exists in the rate of oxidation of potassium and ammonium thiocyanates.
3.—That about 50 per cent. of the nitrogen of the thiocyanate is recovered as ammonia and nitrate, and about 70 per cent. of the sulphur as sulphate.
4.—That denitrification changes do not play an important part in the oxidation of thiocyanates.
5.—That solutions of thiocyanate up to a concentration of 18·7 parts CNS per 100,000 can be oxidized.
6.—That solutions of phenol up to 68 parts phenol per 100,000 can be oxidized on bacterial filters.
7.—That the products of oxidation of phenol are most probably carbonic acid and water.
8.—That the oxidation of phenol may be due to a limited extent to denitrification, but is essentially a direct process.
9.—That the oxidation of phenol proceeds equally in solutions faintly acid or slightly alkaline solutions to phenolphthalein.
10.—That phenol is more rapidly oxidized on bacterial filters than thiocyanates.
11.—That the oxidation of phenol can be brought about by the action of a single species of organism.
12.—That the oxidation of thiocyanate is in all probability due to the combined action of several organisms.

It will be noted that attention has been confined in the foregoing paper to the oxidation of thiocyanates and phenol, as being the main oxygen-consuming constituents of ammonia-recovery liquor. At the same time, it may be mentioned that experiments have been made, and are still in progress, on the oxidation of thiosulphate on bacterial filters.

EXPERIMENTS AT THE MANCHESTER GAS-WORKS.

Owing to the increasing objections that are being raised throughout the country as to the discharge of the waste liquor from ammonia-recovery plants into sewers and waterways, experiments were initiated in 1904 to obtain trustworthy data as to the possibility of purifying these liquors on bacterial filters. Facilities were given by the Gas Committee of the Manchester Corporation for the trials to be made in connection with their ammonium sulphate plant at the Bradford Road works. The experiments have been carried out under the joint supervision of the authors of the paper; and the analyses quoted have been made in the laboratory at the Davyhulme Sewage-Works. The liquor in all cases has been carefully freed from suspended solids by adequate sedimentation.

A tower filter was constructed of timber. The filtering medium was at first filled in to the depth of 4 yards; the upper surface area being one yard. Hard, screened boiler clinker was used of the following sizes, beginning from above downwards: 4 ft. 6 in., ¼ in. to ½ in.; 6 feet, ½ in. to 1 in.; 1 foot rough clinker. The filter was put into operation on May 7, 1904. Indifferent results were obtained on attempting to purify the waste liquor directly on ordinary clinker in July, 1904; and therefore the upper cubic yard of medium was replaced by material from the Davyhulme Sewage-Works, and the crude liquor was diluted with water. Distribution was effected by dripping from a height on to a brick, from which the liquid splashed in a fine spray.

It was quickly realized that only in a few exceptional cases would it be possible to utilize fresh water for dilution, on account of the expense. Arrangements were therefore made, by means of duplicate tanks, to mix the crude liquor with 9 volumes of the effluent, and to pump this mixture up to the top of the filter. At the same time, one volume of purified effluent (equal to the volume of crude liquor) passed away continually into the sewer. [These arrangements are shown in a diagram.] A record of the experiments during 6½ years is given in Table VI.

It is of interest to note that recent bacteriological examinations of the purified effluent have shown that large numbers of organisms are present, and among them an organism similar to the one described in the paper read before the Royal Society in November last, and which is capable of actively oxidizing phenol.

From the data in the table, the points to be emphasized are:

1.—The filter has been at work for six years, and is still as efficient as ever.
2.—The effluent from the filter can be used for dilution; no other diluent having been employed for eighteen months.
3.—A high percentage purification is obtained—viz., from 55 per cent. to 84 per cent., calculated on the diluted liquor, which is equivalent to 92 per cent. and 98 per cent. respectively when calculated on the undiluted liquor.
4.—The material has never been rescreened. At the end of two-and-a-half years, the material was taken out for examination on account of unexplained deterioration in results,

TABLE VI.—*Record of Trials of the Experimental Filter at the Bradford Road Gas-Works.*

Date. From.	Date. To.	Rate of Flow per Cubic Yard per Diem.	Dilution. Diluent.	Dilution. Per Cent. of Waste Liquor.	Per Cent. Purification, Inlet to Outlet (with Dates of Sampling).	Remarks.
1904.	1904.					
May 7	May 21	24	Nil	100	20 June 9	
July 20	July 30	6	Water	10	52 Aug. 20	Top cubic yard of filtering medium replaced with material from Davyhulme Sewage-Works.
Sept. 4	Sept. 21	6	,,	15	92 Sept. 15—19	
Sept. 21	Oct. 14	6	,,	15	91 Sept. 21—Oct. 4	
Oct. 15	Nov. 24	6	,,	20	94 Nov. 15—18	
	1905.					
Nov. 29	Jan. 13	6	,,	25	68 Nov. 29—Jan. 13	
1905.						
Jan. 25	March 10	12	,,	25	81 Feb. 18—Mar. 8—9	
March 13	April 17	24	,,	25	82 Mar. 13—24, April 15	
June 19	June 24	33	,,	25	67 June 21	
Sept. 12	Dec. 14	50	,,	25	68 Oct. 23—24, Nov. 15	
1906.	1906.					
Jan. 15	Jan. 27	17	,,	25	11 Jan. 25	
April 10	April 19	8	,,	10	83 April 10—19	
Aug. 13	Sept. 2	27	,,	10	93 Aug. 22, Sept. 1	
Oct. 23	Nov. 19	27	Effluent water one day per week	10	91 Oct. 24, 7, 9, 31—Nov. 1	
Nov. 19	Dec. 15	27	Effluent water	50, 40, 10	76 Nov. 21, 4, 7—Dec. 6, 8, 12	Dec. 4, 1906.—The top layer of fine coal removed, and filter made 3 yards deep.
	1907.					
Dec. 31	Feb. 23	27	,,	10	68 Jan. 9, 19, 30—Feb. 13, 21	
1907.						
March 4	April 11	27	,,	10	77 Mar. 9, 18	
May 28	June 15	103	Effluent	10	75 June 3, 6, 7, 8, 11, 12, 14, 15	
Aug. 14	Oct. 1	103	,,	10	75 Aug. 24, 8—Sept. 14, 20, 24, 27	
Oct. 9	Oct. 19	103	,,	10	52 Oct. 17—19	
Oct. 29	Nov. 28	70	,,	10	50 Nov. 1, 2, 7, 9, 12, 14, 22, 28	
Dec. 11	Dec. 24	70	Water one day per month	10	59 Dec. 13, 16, 17, 19	
1908.	1908.					
Jan. 2	Feb. 22	70	,,	10	62 Jan. 14, 29—Feb. 1, 10	
Feb. 28	April 15	70	,,	10	74 Mar. 10, 28—April 6, 15	
Aug. 19	Oct. 10	70	,,	10	72 Aug. 28, 31—Sept. 4, 5	
1909.	1909					
April 29	May 12	17	Effluent	10	64 April 30—May 12	
May 12	May 20	33	,,	10	75 May 13, 20	
July 1	July 17	70	,,	10	83 July 2, 16	
Oct. 5	Oct. 16	83	,,	10	69 Oct. 12, 13, 14	
	1910.					
Nov. 28	May 14	100	,,	10	59 Jan., March, April, May	
June 14	July 15	100	,,	10	81 June 30—July 12, 15	
Aug. 8	Aug. 28	100	,,	10	84 Aug. 16, 27	
Sept. 6	Sept. 23	100	,,	10	62 Sept. 7, 10, 14	
Oct. 4	Oct. 30	100	,,	10	72 Oct. 12, 14, 20	

Note.—During these runs, the filter was at rest each Sunday for 24 hours.

The material was not sterile, and was replaced, with the exception of the fine surface layer and 3 feet of upper material. The material from Davyhulme became mixed with the screened boiler clinker on refilling.

5.—For the last year, the rate of flow has been constant—viz., 100 gallons per day per cubic yard. This appears to be the economic rate for an average liquor.

Assuming an outflow of 4000 gallons of waste liquor per ton of sulphate of ammonia made, a filter-bed of 400 cubic yards will be required per ton of sulphate made per diem. This is, of course, simply an average figure. Such an estimate should ensure about 90 per cent. purification, calculated on the crude liquor; and for discharge into sewers communicating with sewage-works this should be ample. Experience has shown that where the local conditions are favourable, the bacterial method is likely to be less costly than any other process which can ensure an equivalent degree of purification.

EXPERIMENTS AT BRADFORD CORPORATION CHEMICAL-WORKS.

The experiments at these works were begun, at the request of the Bradford Corporation Gas Committee, in May, 1908. The flow of liquor at the works amounts to 30,000 gallons per day; and it has a higher oxygen absorbed figure than the effluent produced at the Manchester Corporation Gas-Works—viz., over 700 on the four hours' oxygen test, as compared with about 500.

The chemical-works adjoin the Corporation sewage-works, and certain experimental sewage-filters were available for the bacterial purification of the waste liquor. After consideration of the local circumstances, it was decided, with the consent of the Sewage Committee, to utilize one of these filters for the purpose of the experiment. Arrangements were readily made for conveying the liquor to this filter, and water from the stream near the chemical-works was used for dilution; this being made in an old boiler of some 5000 gallons capacity.

The filtering medium used was hard clinker of the following dimensions, beginning at the top: 6 inches, $\frac{1}{8}$ inch to $\frac{1}{4}$ inch, 2 ft. 6 in., $\frac{1}{4}$ inch to 1 inch; 1 foot, 1 inch to 2 inches; and 1 foot of large clinker up to 6 inches. The total depth of the filter was thus 5 feet, and the superficial area was 24 square yards; giving a total cubic filter space of 40 cubic yards.

The distribution was effected by means of lead gutters dripping on to small pieces of slate. The filter, with the necessary pumping arrangement, was ready for use in October, 1908.

During the earlier period of working the filter, several difficulties were encountered—viz., preliminary inoculation, strength of liquor, and frost. Eventually, in July, 1909, the filter was re-inoculated with an extract of soil which had been covered with cow dung, and which quickly showed a strong development of nitrate. The liquor was now diluted 19 to 1 instead of 9 to 1. At this dilution more organisms were found in the liquid before filtration than after filtration—a state of things which is characteristic of filters in good condition.

From this time the results improved until in November, 1909, it was possible to pass through 3200 gallons with a reduction, in the 3 minutes' oxygen test, from 24 to about 5, or nearly 80 per cent. As already stated, the Frizinghall (Bradford) liquor is considerably stronger measured by the oxygen test than the liquor at Bradford Road, Manchester; consequently, the rate of flow just mentioned, which equals 80 gallons per cubic yard, compares very well with the 100 gallons per cubic yard obtained at Bradford Road, Manchester.

Up to this time, however, water or dilute sewage from the neighbourhood of the chemical-works had been used for dilution, partly owing to the difficulty in operating the pump, necessary if the effluent from the filter itself was to be used for dilution. Towards the end of February of this year, it was, however, possible to use the effluent for dilution purposes; and a 12-days' run was given to the filter under these conditions—the flow varying from 3250 to 3500 gallons per 24 hours, or between 80 and 90 gallons per cubic yard. Under these conditions, an effluent was obtained with a four hours' oxygen test of 12·2, compared with the same test for the crude liquor of 738—that is to say, a total purification of over 98 per cent.

In Table VII. are given the final results obtained when using the effluent from the filter for diluting purposes.

This result was highly satisfactory, and, judging from the long experience with the Manchester filter, there seemed no reason to doubt that such results can be maintained. An examination of the filter on March 21 last showed that practically no clogging had taken place. The presence of live worms in the upper layer of the filter indicated that the conditions were favourable for organic life.

In the light of these experiments, the Bradford Gas Committee arranged to equip a large circular filter one-tenth of an acre in area and 8 feet deep, adjoining the experimental filter, in such a way that from one-quarter to one-third of the total quantity of liquor might be dealt with thereon.

The material is again hard clinker graded as follows, beginning at the top: 6 feet, $\frac{1}{4}$ inch to 1 inch; 1 foot, 1 inch to 2 inches; and 1 foot up to 6 inches. The distribution is effected by a rotary trough sprinkler. The pumping arrangements are nearly completed; and it is hoped that the filter may be put into operation at an early date.

TABLE VII.—*Results Obtained from Experimental Filter Treating Mixed Effluent and Crude Liquor.*

[Figures in parts per 100,000.]

—	Crude Liquor.	Mixture of the Crude Liquor and Effluent.	Final Effluent.
Character of samples	Turbid, reddish brown, tarry smell, alkaline reaction.	Brownish liquid, tarry smell.	Clear, yellow liquid, no smell.
Oxygen absorbed—			
Four hours' test	738	30·00	12·20
Three minutes' test	448 (one sample)	24·00	10·20
Nitrogen—			
Ammoniacal	27·7	4·75	5·08
Albuminoid	18·5	0·98	0·59
Nitrous	..	strong	Fair
Nitric and nitrous	..	0·90	1·44
Chlorine	..	135·20	128·00
Sulphocyanates	..	Present (dark brown with ferric chloride)	Present (red colour with ferric chloride)
Phenol	..	Present	Nil
Alkalinity (N/100 acid per 100 c.c.)	..	26. M.O.	18. M.O.
Bacteria per c.c.	Nil	¼ c.c. plates liquefied in three days	320,000 approx. in three days
Rate of flow per cubic yard	..	80—87·5	..
Percentage purification, calculated on oxygen test.	..	..	Calculated on mixed liquid, 59; Calculated on crude liquor, 98
Remarks	Average of two samples analyzed in Dr. Wilson's laboratory and in Manchester.	..	..

Discussion.

The CHAIRMAN (MR. R. H. Clayton) said a great deal had been done lately with a view to the prevention of the contamination of waste liquors by phenols and sulphocyanides. It had been found that phenols were practically constant in all parts of gas liquor. They could not prevent the condensation of the phenols merely by keeping the liquors hot. Gas-works liquor contained a large amount of sulphocyanide. In one works with which he was acquainted, where the gas was well scrubbed, it contained up to 1 per cent. This was not the case with coke-ovens, where the percentage was something like 0·1. Some years ago, Dr. Frankland made experiments with a liquor similarly diluted, but with 90 per cent. of domestic sewage. A satisfactory product was obtained with three contacts. In what respect did the process of one contact described by Dr. Fowler show an advantage? He also wished to know if the filter described showed any advantage over those used at the sewage-works? He understood that it was necessary to have double contact to get to a certain final point. Was it the intention to be able to get down to a one-grain limit, by treating the stronger material before it went into the sewer?

Mr. O'SHAUGHNESSY thought, from the sewage expert's point of view, the importance of the papers could not be exaggerated. The question, from a financial point of view, was that the antiseptic bodies were prevented from going into the sewage, and inhibiting the purification of the whole body. Had Dr. Fowler investigated the effect of septic action? There was an enormous power possessed by an oxidizing filter for transferring oxygen directly to the bodies dealt with. Also, had the authors ever discovered any serious choking of the primary filters?

Mr. COLEMAN asked if sulphides were oxidized.

Mr. H. L. TERRY understood that where nothing very definite was done with regard to ammoniacal liquors, it was recognized that they brought down the efficiency of the outfall works.

Mr. ROSS remarked that with a fairly strong effluent, as described, a high oxygen figure was obtained at the works. What was the relative putrescibility of the sewage effluent?

Mr. G. GUNN said that at the works with which he was concerned they had to purify 2 million gallons of water every 24 hours by means of mechanical filters. At certain times there were large quantities of river water which was quite brown. They attributed this colour to gas-works letting in tar liquors. Apparently the particular organism mentioned in the papers was not able to cope with the situation, as the colouring matter went right through the filter; and the filtrate was in a fluorescent condition. On running this water on to open sand beds, the whole of the colouring matter was taken out. The sand beds could be used for thirteen weeks without being cleaned.

Mr. D. H. BYROM asked what became of the ferrocyanide, and whether there was any trouble arising from the iron precipitate in the way of clogging.

Dr. CRAIG asked whether it would be possible to purify the gas liquor by precipitating the thiocyanate previous to filtering. He understood this was already being done on a large scale. Would such a process assist purification, and would it be profitable from a financial point of view?

Dr. F. W. SKIRROW said the nitrifying bacteria did not appear to have much to do with the oxidation, but that one particular kind of bacteria, which had as yet only a very nebulous name, did the work. The phenol and sulphocyanide liquors were apparently much more dilute at the sewage-works than the strength which Dr. Fowler had given as the *optimum* for purification; and naturally the conclusion would be arrived at that the nitrifying bacteria did not do the work on the phenol and the sulphocyanide.

Dr. J. GROSSMANN was of opinion that the cyanide originally present in the liquors was converted into sulphocyanide on standing. In a coke-works, the same quantity of coal was passed through; and practically the same amount of ammonia was obtained and distilled off each day. Therefore, in a coke-works the liquor was probably not kept in stock more than three days; and comparatively little sulphocyanide was formed. In the case of a gas-works, the amount of ammonia distilled varied at different seasons. In some cases the liquors were stored over the summer months; being constantly stirred up by the addition of fresh liquor, and brought into contact with oxygen. The sulphuretted hydrogen became oxidized to a certain extent; free sulphur being formed, which combined with cyanogen. He had tried to oxidize waste gas liquors by blowing air through, and had succeeded in oxidizing a certain amount of the sulphocyanide. He could not, however, get rid of the phenols; and he gave the matter up as hopeless. He had come to the conclusion that it would be practicable to evaporate the liquors at gas or coke works, because there was always a considerable amount of waste heat available, as with suitable plant one could evaporate about 7 lbs. of water per pound of coke or its equivalent in waste heat. There was one point which Dr. Fowler seemed to have overlooked—viz., that in the oxidation of the sulphocyanides and the thiosulphates there must always be free acid formed. Therefore the liquors, after passing through the filters, must be acid, or, if not acid, must have combined with something else which was formed. Dr. Fowler had made his experiments on potassium and sodium compounds. But the liquors, of course, contained calcium compounds; and it might have been more satisfactory if calcium sulphocyanide had been used. The technical difficulties in the adoption of Dr. Fowler's method were considerable; the available space at a gas-works was generally limited, while there was an abundant amount of waste heat available; and he therefore considered the boiling-down of the liquors the shortest and most satisfactory solution of the problem.

Mr. GUNN further inquired whether, if the bed at the sewage-works was inoculated with the particular bacteria, in addition to those which were present for nitrifying, the action took place side by side with the oxidation action.

Mr. GAUNT asked whether it would be practicable to control the temperature at the works. He understood that, after the settling-out of the lime, the temperature was something over 30° C.

Dr. FOWLER, in reply, said a few experiments had been tried with percolating filters, which indicated that as good results could be obtained as with contact beds. The experiments in the laboratory were chiefly by contact, because of the greater convenience and more accurate working; though on a practical scale he had always chosen the percolating filter, because of its economical construction. The question of cost largely conditioned the matter. He rather agreed with Mr. O'Shaughnessy that the main difficulty was distribution. With perfectly accurate distribution, probably better results would be obtained than with contact beds; but there was not a great deal in it. The effect of the ammoniacal liquors that went into the sewers of Manchester was to raise the "oxygen absorbed" figure for the sewage two whole numbers at times; and it was quite certain they could bring this down by filter beds erected at Bradford Road on an area of about an acre. He took Mr. Ross's point perfectly clearly; but the subject was such a large one that it had been purposely left out of consideration. Replying to Dr. Skirrow, the organism was undoubtedly present in the sewage filters at the works. It was not simply a question of nitrification, though this point did enter into consideration, especially in regard to the final oxidation of sulphocyanates. He was quite convinced of the presence of the phenol oxidizing organism in ordinary sewage filters; but it would be much easier to inoculate the comparatively small area required at the gas-works than deal with the whole sewage-works. With regard to the intensification of the strength of the phenol, the point had not yet been worked out. Their limit of temperature was somewhat defined; they would not work at blood heat. A temperature of about 22° C. was the *optimum*. There was no reason, as Mr. Gaunt had remarked, why the temperature should not be regulated exactly. The question of cost was a difficult one to discuss at a meeting like the present. In the case of the Bradford experiments, all the conditions were favourable, as the foundations for the filters were immediately available, and it was only necessary to fill them with the medium. As the result of an actual tender for a filter to deal with a daily output of 5000 gallons of liquor, the cost was £200 for the pump, filter, tanks, and everything else. The cost of pumping was the main cost. There were 500 cubic yards of filter space. In many places in Scotland, the liquor was evaporated, though there was a certain amount of nuisance arising from the process. In the absence of a definite assurance from Mr. Gunn that the river water he mentioned contained gas liquor, it was impossible for him (the speaker) to express an opinion. Regarding Dr. Grossmann's suggestion as to the oxidation of dilute solutions without bacteria, he did not anticipate any great success for it, for the simple reason that air had been bubbled through solutions for weeks and months, and nothing had happened in control experiments on bacterial action. In the case of phenol, nothing happened with the pure culture of the *B. fluorescens*. It

was not until the actual organism required was put in that the phenol disappeared. The question of free acid was an interesting one; but he would remind Dr. Grossmann that they obtained ammonium sulphate. The nitrogen was converted into ammonia. It was true the liquors were slightly alkaline with lime to begin with. The acidity rose as the effluent passed through the filter; the filtrate containing bicarbonates. With the small quantity of lime present in most clinker materials, it took a very long time for it to be completely dissolved by the small traces of acid. If it were not for the fact that they could not find any sign of phenylsulphuric acid being formed, one would, of course, be inclined to think it was a very likely reaction, as had been suggested by Dr. Schryber. It was his (the speaker's) intention to experiment with the action of other phenol bodies, such as salicylic acid. The question of calcium sulphocyanate was of some interest; but they had not, as a matter of fact, used this compound. They had obtained results with potassium sulphocyanate in the laboratory, and also with calcium thiocyanate in the works.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

The Arrangement and Use of Tar-Towers.

SIR,—I am obliged to your correspondent, Mr. A. Edwards, for giving me an opportunity of more clearly explaining the conditions under which we work our tar-towers without equilibrium pipes.

He is, of course, quite correct in stating that, where the tower is under atmospheric pressure, the liquor in the hydraulic main outside the dip-pipes rises above the level of the tower overflow to the same extent as the vacuum. For instance, in our case, working at 1¾ inches of vacuum, the liquor rises 1¾ inches above the level of the tower overflow. In working without equilibrium pipes, we set our tower overflows at, practically speaking, the same level as the bottom of the dip-pipes. This position was arrived at by lowering the overflow to a point at which air was not drawn up the ascension-pipes when the retorts were open. As Mr. Edwards states, the level of the liquor inside the dip-pipe is, therefore, the same as the level of the tower overflow—*i.e.*, flush with the bottom of the dip-pipes.

Thus the gas, as it is made, has merely to bubble upwards through 1¾ inches of liquor, which gives very little resistance to the flow of gas—its natural tendency being to rise immediately to the top of the liquor.

One of the main points in carbonizing is to get the gas away from the retorts as easily and with as little resistance as possible, so as to ensure that the pressure after the retorts are charged, when the maximum amount of gas is being produced, is as low as is compatible with maintaining a level gauge in the retort when the charge is nearly spent. Working with a seal, as just described, I have often measured the pressure in the retorts at different stages of the charge, and have found that it varies from ½ inch when the retort is freshly charged to level gauge when the charge is spent. Working with a liquor seal, these conditions cannot well be improved upon; and I am, therefore, well satisfied to continue working without equilibrium pipes.

I do not know whether I am right in assuming that Mr. Edwards means to infer that where 1¾ inches of liquor is drawn up on the outside of the dip-pipes by the vacuum, and where the liquor on the inside of the dip-pipes is flush with the bottom, there must be an initial pressure on the retorts of 1¾ inches head of water. This is certainly not the case, as, if it were, the pressure in our retorts would be 1¾ inches, *plus* the pressure given off by the production of gas; whereas it is actually no more than an average of ¼ inch.

G. M. GILL.

Gas-Works, Wapping, E., May 6, 1911.

The Heating of Flueless Rooms.

SIR,—I have read with amazement Mr. Yates's communication in your last issue, and for my part do not intend to take too seriously a man who lets loose, without the slightest reason, the following preposterous accusation: "Instead of the judicial impartiality, the writer is frankly partisan. He lays aside the judge's robe, and becomes the avowed advocate of one type of apparatus as against all others; and not merely of one type, but of one make, for he does not hesitate to name the particular make of apparatus whose champion he has become. But whether as the impartial investigator of former times, or the confessedly partisan advocate of to-day," &c. If this is judicial impartiality, let me be preserved from justice. Since Mr. Yates penned this diatribe, he will have had an opportunity of reading the discussion on the paper, and must now feel exceedingly foolish.

Things have come to a pretty pass if a gas engineer who has an inclination for looking at the scientific aspect of things cannot present his views to a technical association without being made the shuttlecock of traders who may consider their particular interests prejudiced. If Mr. Yates wishes me to continue to look upon him as a scientific gentleman, and not one who will let his commercial zeal overrun his professional discretion, he will unreservedly withdraw his comments.

The sole cause of offence appears to have been the use of the word "Wilson" when referring to the gas-heated circulator. This word would probably have been better omitted; but there is no difference between referring to the Wilson gas-circulator in a technical communication, and (say) the Glover-West vertical retorts, or the Humphreys and Glasgow carburetted water-gas plant. If makers of gas appliances are going to take offence when they hear the name of a rival maker mentioned, my view is that it were better not to invite them to these gatherings.

Mr. Yates has been quite correct in quoting what I said at Manchester; and there is nothing in my recent paper that does not harmonize with the point of view I expounded at Manchester. He has given no quotation from my lecture that will confirm such a definition as he gave of what happens to the products of combustion from a flueless radiator, and which I will repeat, because Mr. Yates does not yet fully appreciate its absurdity.

> "The products of combustion, being warmer than the surrounding air, immediately ascend to the upper part of the room, where the carbonic acid either directly escapes by diffusion, owing to the porosity of the walls and ceiling, or else mingles with the air in the upper part of the room, and eventually escapes in the ordinary way without descending to the breathing level. Once the carbonic acid has mingled with the upper stratum of air, the mixture becomes a perfect one."

Mr. Yates endeavours to make me a party to this erroneous statement of what occurs, by quoting me as having said at Manchester: "When the gas is burning, there is a stream of heated products towards the ceiling." At that time the chief appliance employed for gas lighting was a vertical burner fitted with an enclosing globe or chimney; and while under these circumstances the metaphorical use of the word "stream" was permissible—considering, too, that the light source was not at the floor level, but within 5 or 6 feet of the ceiling—the proposition is altogether a different one with combustion taking place near the floor level, as it does in flueless radiators of all types, and situated from 14 to 40 feet from the ceiling.

It is apparently necessary for me to repeat the law of diffusion, though I should have thought it superfluous were it not for Mr. Yates's persistence—viz.: "The relative velocities of any two gases are inversely as the square roots of their densities." I leave it for Mr. Yates to calculate what will have become of the stream from a gas-radiator before it reaches the ceiling. It is obvious that the carbonic acid cannot escape by diffusion except as a small concomitant of a mixture chiefly comprised of nitrogen and oxygen. If all the carbonic acid, therefore, is diffused in this way, then all the heated nitrogen and oxygen must also be similarly diffused, and there will be no appreciable heating at the breathing level—*i.e.*, where it is required. The hot air which provides the heating is, as a matter of fact, produced by the intermingling of the heated products with the air, except the small proportion coming off in the form of radiation, which does not exceed 20 per cent.

While in a satisfactorily ventilated room the carbonic acid produced from gas used for lighting will be evacuated at or about the ceiling, it is necessary, when gas is used for heating in the form of flueless radiators, that the heated air should "back up" from the ceiling to the floor to such an extent as to give the necessary warmth at the floor level. If Mr. Yates prefers to think that there is no difference in the lighting problem, therefore, I have no inclination to upset any comfort he may derive therefrom.

Dr. Toogood is quite right in stating: "The heated products of combustion ascend quickly above breathing level;" but he does not make the foolish claim that the carbonic acid isolates itself, and diffuses through the walls or remains near the ceiling, leaving the heated air to perform the heating functions necessary. He further says: "A ward or other public building in which gas-radiators cannot be used with advantage is improperly ventilated." There is nothing in this antagonistic to my contention, or to anything I have written or uttered. Gas-radiators can be used with advantage, if proper ventilation is provided. But my attitude is that proper ventilation is easier to provide with the prime heating agent outside and not inside the building to be heated. For adopting this view, which I demonstrated not by hypothesis but by irrefutable figures, I am accused of being a partisan.

Longwood, May 5, 1911. JNO. HY. BREARLEY.

Mr. Brearley's Eastern Counties Association Paper.

SIR,—In looking through the discussion on the above, I notice that I am reported to have said: "They had to fix up at least two radiators in series to get the temperature needed."

The word "radiators" should have read "circulators." Also in the sentence following.

For the sake of those who have taken interest in the paper, I shall be glad if you will publish this correction.

THOS. GLOVER, Engineer and Manager.

British Gaslight Company, Norwich, May 3, 1911.

Concrete Water-Pipes at Clydebank.—The laying of the reinforced concrete water-pipes on the Bonna system for the conveyance of the new water supply to Clydebank is now completed, and the pipes are conveying the water a distance of about ten miles. It is stated that the jointing problem has been solved, and that no trace of leakage can be found. The work was originally placed in the hands of contractors; but the Corporation had to complete it themselves. Nevertheless it is stated that the entire cost, including repairs while the work was in suspense, is less than it would have been with iron pipes.

Gas v. Electricity at East Stonehouse.—The action of the East Stonehouse District Council in accepting the tender of the Plymouth and Stonehouse Gas Company for the lighting of the streets has received ample justification by the publication of the tenders. Mr. W. A. Cleave, the Chairman of the Works Committee of the Council, who made the information public, points out that the use of gas means a saving of £100 4s. 8d. per annum; and he says the information will satisfy the ratepayers that gas is best and cheapest. The tender of the Devonport Corporation Electricity Committee was divided into two parts. In District No. 1, they estimated for 17 lamps of 200-candle power at £5 10s. each, 14 of 150-candle power at £4 4s. 3d. each, and 61 of 75-candle power at £3 each. In District No. 2, they proposed to put four lamps of 150-candle power at £6 8s. 2d. each, and 110 of 75-candle power at £5 3s. The total cost for No. 1 district was £335 9s. 6d., and for No. 2 district £594 17s. 8d.—a total of £930 7s. 2d. For gas the estimate was as follows: 17 lamps of 225-candle power at £9 5s. 6d., 18 of 150-candle power at £5 15s. 6d., and 171 of 75-candle power at £3 10s.—a total of £860 2s. 6d., less £30 rebate on mantles, making a net total of £830 2s. 6d.

REGISTER OF PATENTS.

Producing Gas.

SLICK, E. E., of Pittsburg, U.S.A.

No. 8178; April 5, 1910.

This invention relates to apparatus employed in the manufacture of combustible gases from coal and other carbonaceous materials; the object being to handle the materials so that holes in the fuel-bed are broken up and the manufacture of lean or poor gas is prevented.

In order to achieve this object, it has been proposed, the patentee points out, to provide means for moving one layer or zone of the charge relatively to another layer, and means for rotating certain of the sections —the other sections remaining relatively stationary. According to the present invention, one layer or zone of the combustible portions of the charge in the producer is pushed bodily in a lateral path relatively to another zone or layer of the charge—the movement being produced in various ways. One of these consists in moving horizontally a central section of the producer; in another method, the top section is moved; while a third method consists in moving the bottom section by means of suitable mechanism.

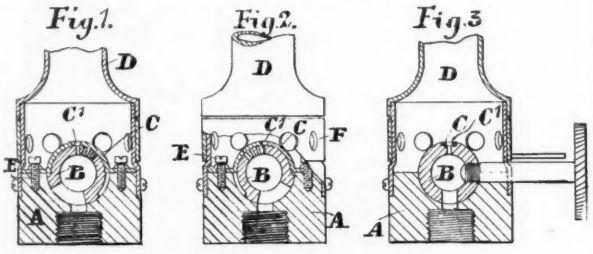
The means employed are fully set forth in a lengthy specification accompanied by six sheets of drawings.

Gas-Burners.

NOAD, A. C., of Middlesex Street, E.

No. 8223; April 5, 1910.

This invention has particular reference to gas-burners with regulators having a number of openings of different sizes formed in the wall of a hollow member which is angularly adjustable so as to bring any one of the openings into coincidence with a stationary aperture through which the gas has to pass on its way to the burner-tube.



Noad's Regulating Gas-Burners.

Fig. 1 is a vertical section of one form of the burner regulator. Fig. 2 shows the movable portion of the regulator in a different position. Fig. 3 is a vertical section at right angles to fig. 1.

The regulator plug A is adapted to be screwed on to a gas-pipe, and has a movable portion B in the form of a hollow ball. This ball fits into a hemispherical cavity in the plug, and is retained in position by a semi-circular band C, which encircles the projecting half of the ball by engaging with a groove upon its exterior. The band has an aperture C^1 in it in a central position with respect to the axis of the usual bunsen burner-tube D, and the ball has four perforations of different size—any one of which can be made to register with the aperture by angular adjustment of the ball. With the parts in the position shown in fig. 1, the first perforation registers with the aperture; whereas in fig. 2 the fourth perforation is shown registering with it. The aperture C is preferably a little larger than the largest of the perforations in the ball; so that in all cases it serves as a short cylindrical enclosure to shield, for a short distance, the jet of gas issuing from one or other of the perforations, and thus permit the jet to attain the form of a single steady column. The band not only retains the ball B on its seating, but restrains it from moving in any direction except that desired. Its ends are secured to the plug by screws E. The resiliency afforded by these washers underneath enables the band to be screwed down so as to bear firmly upon the ball, and yet to yield to any slight irregularities in the shape of the ball. Hence, on the one hand, there is sufficient play to enable the ball to be easily turned, while, on the other hand, the leakage of gas, by reason of too loose a fit, is prevented.

The plug has a hole at the base of its spherical cavity for enabling the gas to pass from the supply pipe into the ball; the latter having an elongated slot opposite the perforations to enable the gas to pass into the interior of the ball for all positions into which it is adjusted. The means for adjusting the ball comprise a rod one end of which is screwed into the wall of the ball and the other provided with a thumb-screw. The abutments at the ends of the groove on the ball serve to limit its movement, and are so placed that when the ball has been turned to the extreme position in one or other direction, the first or fourth perforation is in register with the aperture C^1 in the band, as in figs. 1 and 2.

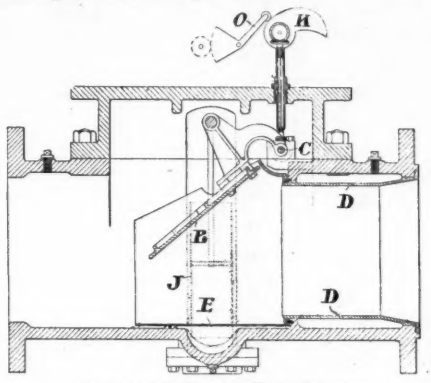
Fluid-Meters.

KENT, W. G., and HODGSON, J. L., of High Holborn, W.C.

No. 8320; April 6, 1910.

According to this invention, there is placed in a pipe through which the fluid to be measured is flowing a weighted door hung on a transverse axis as described in patent No. 11,442 of 1904 for measuring water. The movements of the door due to the variations in the flow are caused to actuate a cam, which operates a pivoted feeler. The cam is so shaped that the angular movement of the feeler is proportional to the flow itself, or, if it be desired to correct for pressure or temperature, to the logarithm of the flow under certain standard conditions of pressure and temperature.

It has previously been proposed to employ a dashpot in connection with such mechanism for the purpose of suppressing the results of small changes in the flow which last only for a short time. But, according to this invention, a dashpot is employed, or preferably a pair of dashpots placed close beside, and coupled directly to, the weighted door; so that the axle on which the door is hung shall be unaffected by momentary changes in the flow, and so that no strain from the dashpots can come upon the recording mechanism.



Kent and Hodgson's Fluid Meter.

As shown, the weighted door B, hung on a transverse axle C, closes against the mouth of the inlet D, so that the pipe is completely closed when there is no flow. A shield E is preferably placed around the mouth of the entrance pipe to furnish a smooth surface within which the door may work. This door is connected to its axle by brackets, which also carry a rod connected to damping pistons working in dashpots J. The angular movements of the axle C may be transmitted to a cam K by bevel gear and a spindle. The cam operates a feeler O, such as is described in the 1908 patent; and the movement of this feeler actuates a spindle through toothed gear.

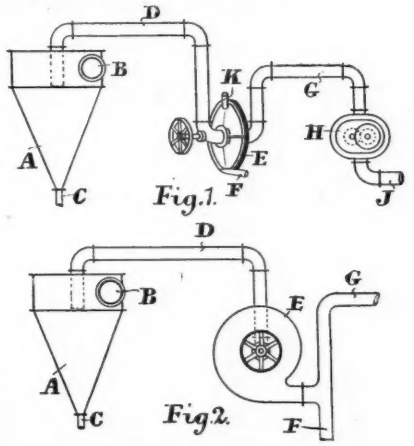
Treatment of Coke-Oven and like Gases.

LLOYD, E., of Sheffield, and SIMON-CARVES BYE-PRODUCT COKE-OVEN CONSTRUCTION AND WORKING COMPANY, of Manchester.

No. 8379; April 7, 1910.

This invention relates to appliances for practically freeing from tar the hot gases of distillation from a coke-oven or the like, so that such tar-free gases can be at once passed to ammonia absorption apparatus.

The hot gases are passed first through a static centrifugal separator at a velocity to ensure the centrifugal separation therein of the denser and heavier tarry matters, and then through a dynamic centrifugal separator, in which the separation of the remaining lighter, finer, or more fluid tarry particles is effected. The gases are then led to the ammonia absorption apparatus or elsewhere.



Lloyd and Simon-Carves Tar-Separators.

In fig. 1 is illustrated the combination with the static and dynamic centrifugal separators of a separate air exhauster to ensure the flow of the gases. In fig. 2, a dynamic separator is illustrated of a type which will not only effect the separation of the tarry matters from the gases, but will also itself propel the gases.

The static centrifugal separating apparatus A, to which the gases are first led through the pipe or opening B, is of the "cyclone" type, with a central overflow pipe C at the bottom for the discharge of the separated matters, and a discharge pipe D at the top through which the gases partially freed from tar are led to the dynamic separator E, having a rotary part of such construction and arrangement that the gases passing through or over such part have their suspended tarry matters centrifugally separated.

In fig. 1, the tarry matters deposited in the casing flow down to the bottom, and are discharged through the pipe F. A centrifugal separating apparatus of this type is not adapted to itself set up the required

flow of the gases through the separators and the rest of the system, and therefore the discharge pipe G, through which the tar-freed gases pass away, is led to a separate exhausting or blowing apparatus H, from which the gases discharge through the pipe J, and are led away to the ammonia absorber or as desired.

In fig. 2, a separate blower or exhauster is dispensed with, and the dynamic centrifugal separator E is itself of such a type as not only to effectually centrifugally separate the tarry matters in the gases, but to also propel the gases through the system. Such a separator is an ordinary centrifugal fan or pump E; to the eye of which the gases from the static separator are delivered through the pipe D, and from the shell or casing of which the tar-freed gases are led away through the pipe G. A limb F of this pipe is led to a trapped well for the discharge of the tarry matters, which are deposited in the casing of the fan and drain away through such pipe.

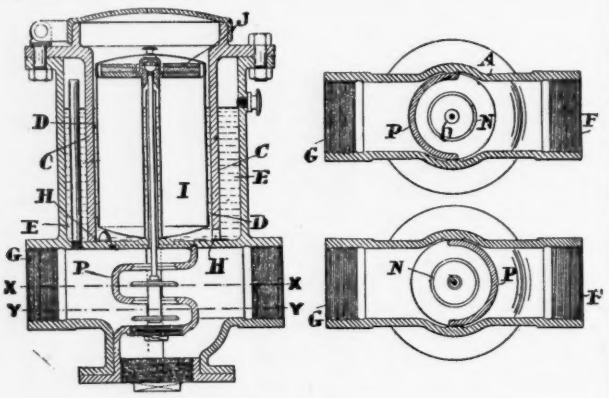
To increase the efficiency of either separator, it may be supplied with tar other than that normally contained in the gases. Conveniently such tar may be injected in the form of spray, and at a temperature above the dew-point of the gases, into the gases just before they enter the static separator, and supply the dynamic separator with a small stream of tar to its rotary member. In fig. 1, the pipe K is employed to so supply a stream of tar to the rotary member of the centrifugal separator E.

Gas-Governors.

FEENY, V. I., of Queen Victoria Street, E.C.

No. 8820; April 12, 1910.

This invention relates to gas-governors of the type described in patent No. 231 of 1893.



Feeny's Gas-Governor.

The illustration shows a central vertical section of the apparatus, and plans on the lines X and Y.

The body of the regulator has the usual flanged top carrying the circular wall C, which separates the central float-chamber D from the outer annular chamber E. The gas inlet F and outlet G are formed integral with the casing below the float-chamber; while an alternative inlet is provided at the bottom of the regulator. The wall C is shown as making contact with the floor of the float-chamber—an elastic filling or cement being used to close the gap. Passages, in the form of semi-circular notches H in the bottom edge of the wall, allow communication between the two chambers. The float I has a cupped upper end and a cover, or else the upper end may be dished and radially corrugated to allow liquid to drain off beneath the weights J. The latter are fitted round a central boss, which forms a seating for the ball of the valve stem. This ball is screwed upon the central stem, and provided with a lock-nut for adjustment.

The gas-valve is constructed as an equilibrium valve having one of the discs N secured to the central stem, and the other slidably supported thereon by a tube O, of tin. The valves themselves may be of aluminium.

The valve-chambers are provided in a separate cylindrical part P, which is fitted into the casing by a flanged joint. The three pockets of this valve-chamber are open upon alternate sides—the central one connected to the gas-inlet F, and the others to the outlet G. The lower gas-inlet is formed in the flanged base of the part P in line with the valve-seatings, and communicates through a port with the main inlet. The floor of the bottom pocket is also provided with an opening in this line, which is closed by a screw plug.

The sides of the part P contact with vertical facing strips upon the inner surfaces of the lower portion of the casing; a vertical flange forming the wall of the upper pocket fitting into a circular groove beneath the floor of the chamber D.

The top of the float-chamber is enlarged in area, to prevent the overflow of liquid; and a cover fits over this enlarged portion, provided with a lug entering a fork in the head of one of the bolts, so that it may be secured by a padlock or other means. The usual gas-tubes connected to the outlet pressure are inserted in the float and annular chambers respectively.

Gas-Generating Plant.

WHITE, M. & H. J., of Luton.

No. 10,357; April 27, 1910.

This invention refers to the production of gas from wood and other refuse for use in driving engines or for heating—more particularly to apparatus of the type in which the gas is generated in a substantially cylindrical producer having a fuel-charging hopper above the roof of the producer, and in which the producer is surrounded at its upper part by an annular chamber (into which the gas passes) provided with means for removing the dust deposited from the gas; the gas being then conducted to where it is to be utilized in any desired manner.

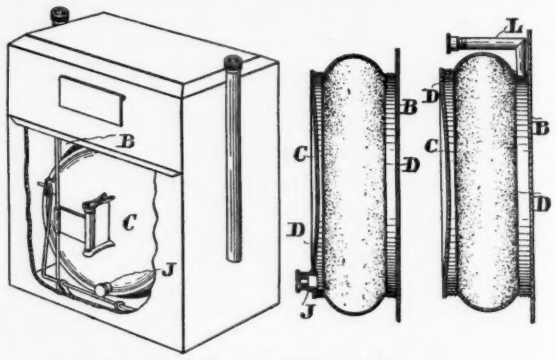
The "invention" consists in the means whereby the gas produced in the generator is passed into an annular chamber surrounding it, where it is submitted to the action of a spray of water in order to separate from it the dust and the like. It is afterwards passed through a rotary scrubber, whereby the tar and resinous matters are extracted; the gas being finally discharged for use "in a highly-purified condition."

Gas-Meters.

DANAHER, J. W., and SLAGHT, E. E., of Toronto, Canada.

No. 10,784; May 2, 1910.

It is the object of this invention to provide means for oiling the leather of dry meters from the inside, to which end an oil opening is provided in the bellows adjacent to the leather sides—the opening draining the bellows as well as forming an oil inlet.



Danaher and Slaght's Dry-Meter Bellows Oiler.

A perspective view is given of a meter constructed in accordance with the invention, and sections of the bellows showing two modifications of the arrangement.

The partition B forms one end of each bellows; the outer end being formed by a disc C. The partition and disc are each provided with a flange D, to which the leather forming the sides of the bellows is attached. In the first (preferred) construction, a hole is formed in the disc close to its edge; so that it will not only serve for the introduction of oil, but also for draining out any surplus. A threaded flange J is provided, with a screw cap. As a variation, the opening may be made in one of the flanges—preferably that one connected to the partition B. A tube L is connected with this opening, and extends to any convenient position; its end being closed by the screw cap.

With each form, the mode of operation when the bellows leather is to be oiled is as follows: A sufficient quantity of oil having been poured in, the meter is slowly rotated so that the oil runs round the leather, thoroughly soaking it. The surplus oil is then drained out, and the closure again applied. It will be necessary, the patentees remark, to unsolder the back and front of the meter to get at the bellows; but this has to be done in any case. With their construction, however, the cost of cutting open the discs, replacing the parts, and re-adjusting the meter, is avoided; and, as meters require to have their bellows re-oiled every three to five years, they say, "the total saving during the lifetime of the meter is considerable, while the increased expense of this construction is exceedingly small."

Treating Tar to Obtain Oils Containing a High Percentage of Bitumen.

BARTEL, R., of Halensee, Germany.

No. 17,639; July 25, 1910. Date claimed under International Convention, July 27, 1909.

In the course of his specification, the patentee remarks: Tar obtained in the distillation of coal contains a large amount of substances which in themselves contain bitumen. When the tar is subjected to the usual treatment by distillation, only the constituents of comparatively low boiling point can be obtained undecomposed; whereas the bituminous substances cannot be distilled without being decomposed. The distillates obtained accordingly possess none (or very few) of the valuable properties of bitumen; the greater part of the bitumen originally contained in the tar remaining in the pitch. If pitch be subjected to distillation, the bitumen contained in it is, for the greater part, destroyed, so that the pitch cannot be converted into bitumen by distillation, while the coke obtained at the same time cannot readily be used.

It has already been proposed to isolate the bitumen from tar by solvents; but the solvents hitherto proposed, and the method and manner of using them, have the disadvantage that large amounts of solvents must be employed and can only be recovered with much loss and at heavy cost. There are also great difficulties in separating the solution from undissolved substances, owing to the clogging of the filtering cloth and the like. Hitherto oils of as high a boiling point as possible, or large amounts of solvents of low boiling point—for example, forty parts of solvent to one part of tar—have been used for this extraction [see Muspratt's "Technische Chemie," 1905 Vol. VIII., p. 3, and Dingler's "Polytechnisches Journal," Vol. 208, p. 336 *et seq.*] It has also been proposed to treat tar for the purpose of separating the lighter from the heavier liquid hydrocarbons by acidulation and the addition of suitable vegetable or mineral oil, or of petroleum residue, or of benzol.

The present process is based on the inventor's observation that by

using benzene as a solvent, without acidulation, the difficultly soluble parts of the bitumen will, when the proper quantity of the solvent is employed, dissolve in a practically complete manner, and the disadvantages mentioned will be avoided. The amount of benzene for the treatment of the tar is preferably so chosen that at most one litre of benzene is used for each kilogramme of tar. The solubility of bitumen in benzene has been established by the following determinations, which have not hitherto been made known.

Quantity per Kilogramme of Tar.	Parts per Litre of Benzene.	Insoluble.
1 ..	1 ..	3·25 per cent.
1 ..	2 ..	4·77 ,, ,,
1 ..	3 ..	5·09 ,, ,,
1 ..	4 ..	6·9 ,, ,,
1 ..	5 ..	6·7 ,, ,,
1 ..	30 ..	6·1 ,, ,,
1 ..	40 ..	5·45 ,, ,,

If, therefore, at most, one litre of benzene be used for each kilogramme of tar, oils which are richest in bitumen are obtained.

As an example, he gives the following: 1 kilogramme of tar is mixed by stirring with 1 litre of benzene (the 90 per cent. commercial product) while being gently heated; and, after cooling, it is filtered or decanted. From the clear filtrate, the benzene is distilled off, thereby giving a clear oil, which contains the whole of the bitumens in the tar treated. It should be noted, he points out, that the separation of the dissolved constituents from those which are undissolved can be readily effected by decantation or filtration, whereas in the other methods of working, and with other solvents, the separation always presents difficulties.

Purifying Gas.

FALDING, F. J., of New York, and CATHCART, W. R., of Hackensack, New Jersey, U.S.A.

No. 20,245; May 7, 1910.

The patentees' proposal is to scrub the gas with a solution of an iron salt (thereby producing a wash-liquor containing an ammonium salt in solution and iron hydrate), and subject this wash-liquor to the action of an oxidizing agent to convert the soluble iron hydrate into iron hydrate, which is insoluble in the presence of the ammonium salt. The precipitate is readily separable from the solution of ammonium salt in a form suitable for metallurgical purposes; while the ammonium salt may itself be recovered from the solution, if desired, in any suitable manner. If desirable, prior to subjecting the gas to the treatment described, they first free it from impurities in the form of sulphur, sulphides, cyanides, or chlorides. Preferably the solution of an iron salt referred to is that known in the iron and steel industry as "waste pickling liquor," and it is employed in the sulphate form.

If ammonia (NH_3) is added to a solution of ferrous sulphate in the presence of water, the following reaction takes place:

(1) $2NH_4OH$ (or $2NH_3 + 2H_2O$) + $FeSO_4 = (NH_4)_2SO_4 + Fe(OH)_2$.

The ammonium sulphate will remain in solution, and the ferrous hydrate will be only partly precipitated; it being soluble in the presence of the ammonium salt. If the solution is subjected to the action of an oxidizing agent (as by passing a current of air through it while heated), the ferrous hydrate will be converted into ferric hydrate or some intermediate oxidation product, or a mixture of such products, for example:

(2) $2Fe(OH)_2 + H_2O + O = Fe_2OH_6$; and
$3Fe(OH)_2 + O = Fe_3O_2(OH)_4 + H_2O$.

These ferric and ferroso-ferric hydrates are insoluble in the presence of ammonium salts, and therefore precipitate completely.

The gas is preferably given a preliminary treatment in order to free it from sulphides. For this purpose, it is scrubbed with sufficient of the pickling liquor to produce enough ferric or ferrous hydroxide to precipitate the sulphur in the gas as iron sulphide and free sulphur. Instead of the pickling liquor, ferrous hydroxide, or preferably ferric hydroxide, may be used. This step of the process may be carried out either with or without heat and oxidation as may be necessary, and according to the solution of iron salt employed. The precipitate will carry down some of the tarry matters of the gas, and cyanogen and chlorine compounds of the same contained in the gas will be precipitated. The precipitate may be further treated for recovering the sulphur and cyanogen and chlorine values, together with iron hydroxide.

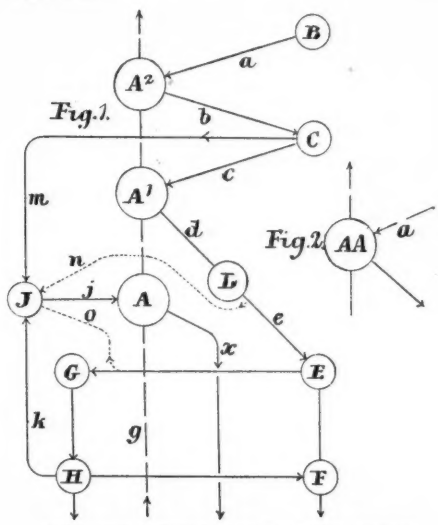
The gas, freed from sulphides, cyanides, and chlorides is now scrubbed with the waste pickling liquor containing the necessary equivalent of sulphuric acid to combine with the ammonia contained in the gas; and the mixed solution is oxidized, by heating it and passing a current of air through it, or in any other suitable manner. There will thus be produced ammonium sulphate in solution (which can be recovered in the usual way), and a precipitate of insoluble iron hydroxide, which will be practically free from sulphur, as also from cyanide and chloride, and may be washed and filter-pressed and prepared for use as an iron ore or otherwise. In order that all the iron may be precipitated as hydrate, the solution should at all times be slightly alkaline, so that a slight excess of ammonia should be present.

A practical embodiment of a plant in accordance with the invention is illustrated diagrammatically. Fig. 1 is intended to illustrate a preferred way of carrying out the process when the amount of sulphides in the gas to be purified is small compared to the amount of ammonia therein. Fig. 2 illustrates a simplified process which may preferably be used when the gas contains a larger proportionate amount of sulphides.

The process, as illustrated by fig. 1, calls for the use of a plurality of scrubbers, or scrubbing chambers, or compartments A, A^1, A^2. Scrubbers of any suitable form may be employed; and the number may be varied as found desirable. There will be, however, a preliminary scrubber A, and one or more main scrubbers—preferably two—A^1 and A^2. The dotted line *g* represents the path of the gas, which, after having preferably been freed of its tar as completely as possible, passes first into the scrubber A; and then from scrubber A to scrubber A^1; and thence to the scrubber A^2, from which the gas passes fully purified.

In the preliminary scrubber A, the gas has its maximum temperature, and is relieved of its sulphides, cyanides, and chloride, &c.; and in the main scrubbers A^1 and A^2, the ammonia is taken from the gas, which will then leave the scrubber A^2 completely freed of its ammonia, sulphur, cyanogen, and chlorine constituents, as well as all other impurities it contains, with the possible exception of carbon dioxide, which it may be necessary to take from the gas by further treatment before sending to the mains.

Supposing waste pickling liquor of the sulphate form or other solution of ferrous sulphate to be used for scrubbing the gas, and following the successive steps of the process in the direction the reverse to that of the flow of the gas through the scrubbers, the scrubbing solution will pass from a suitable source, as a storage tank B, to the scrubber A^2, as indicated by the line *a*. In the scrubber A^2, the solution of ferrous sulphate will meet the partially purified gas, which will be completely freed of the ammonia it has retained on leaving the scrubber A^1; the ammonia combining with part of the ferrous sulphate in the scrubbing solution to form ammonium sulphate and ferrous hydroxide with some ferric hydroxide—the ferrous hydroxide being partly soluble and partly insoluble in the presence of ammonium sulphate. The scrubbing liquor will, however, be supplied in such quantities, and of such strength, that its sulphuric acid will not be entirely transformed into ammonium sulphate in the scrubber A^2. The scrubbing liquor, therefore, as it leaves the scrubber A^2 will consist of a solution of ferrous sulphide and ammonium sulphate with iron hydroxide partly soluble and partly insoluble. This scrubbing liquor may then go directly to the scrubber A^1, or may (and preferably will) first go, as indicated by the line *b*, to a settling tank C for separating from the solution the insoluble ferrous hydroxide. From this settling tank the scrubbing solution passes to the scrubber A^1, as indicated by the line *c*. In this scrubber, it will meet the gas which has been freed of its sulphide, cyanogen, chloride, &c., in the preliminary scrubber A but which retains practically all its ammonia. The sulphuric acid will here be entirely converted iuto ammonium sulphate; and the wash-liquor, as it leaves the scrubber A^1, will consist of a solution of ammonium sulphate and soluble iron hydroxide with some insoluble iron hydroxide. This wash-liquor is then oxidized to convert the soluble iron hydroxide into insoluble iron hydroxide.



Falding and Cathcart's Gas Scrubbing Process.

As shown by the diagram, the wash-liquor passes from the scrubber A^1, as indicated by the line *d*, to the oxidizer D, and thence, as indicated by the line *e*, to a settling tank or filter press E, for the purpose of separating the precipitate of iron hydroxide from the ammonium sulphate solution. The ammonium sulphate solution then goes to a concentrating, crystallizing, and drying apparatus F; and the precipitate of iron hydroxide is treated for recovering the iron hydroxide, as by being passed through a washer G, the wash water of which will contain a small quantity of ammonium sulphate in solution and the iron hydrates in suspension, then going to a filter press H for the separation of the iron hydroxide from the solution. The weak ammonium sulphate solution may then pass from the filter press H to the concentrating, crystallizing and drying apparatus J.

The scrubbing liquor for the preliminary scrubber A, shown by the line *j* as passing to the scrubber from the tank J, is preferably formed by wash water taken from the filter press H, as indicated by the line *k*, together with ferrous hydrate, which may be taken from the settling tank C, as indicated by the line *m*, and mixed with the wash water in the tank J. Instead of this, however, fresh pickling liquor, or a solution of ferrous sulphate, might be used for the preliminary scrubbing in the scrubber A; or part of the solution of ammonium sulphate with ferric hydrate in suspension might be diverted for this purpose after leaving the oxidizer D, as indicated by the dotted line *n*. Or, again, part of the precipitate of ferric hydrate taken from the settling tank or filter press E might be taken to the tank J, as indicated by dotted line *o*, and there mixed with the wash water from filter press H or other suitable liquor. In this preliminary scrubbing in the scrubber A, the sulphides, cyanides, and chloride contained in the gas will be broken up, and the sulphur, cyanogen, and chlorine will combine with the iron to form iron sulphide, cyanide, and chloride, &c. The wash-liquor from the scrubber A, containing soluble and insoluble compounds, may then be worked up separately for the recovery of the various products present; this wash-liquor being removed to a suitable recovery plant, as indicated by line *x*.

By the process as illustrated in fig. 1, not only is a better purification of

gas said to be obtained, but at the same time there is effected a separate recovery of the ammonia from the gas in the form of an ammonium salt; this involving the recovery of acid from the pickling liquor. The iron also from the pickling liquor, or other iron salt solution used for scrubbing the gas, is separately recovered in a form suitable for metallurgical and other purposes.

If the gas contains a proportionate large amount of sulphides, it may be preferable to omit the preliminary scrubbing of the gas, and take the sulphides together with the cyanides and chloride from the gas in the main scrubbing operation, letting the iron sulphates mix with the iron hydroxides. This manner of carrying out the process is illustrated by fig. 2, which shows a single scrubber A, although it will be understood that two or more scrubbers might be used—the gas passing through them successively. As shown by the diagram, the ferrous sulphate solution enters the scrubber, as indicated by the line *a*, and the ammonia contained in the gas combines with the ferrous sulphate, forming a solution of ammonium sulphate containing the iron and the various impurities of the gas, both soluble and insoluble. This mixture of soluble and insoluble compounds can then be treated for the recovery of its values; the iron dissolved in same being oxidized and precipitated as already described.

Controlling from a Distance the Lighting and Extinction of Gas-Lamps.

AUBERT, A. M. & J. M., of Billancourt (Seine), France.

No. 8436; April 7, 1910.

The patentees remark that systems are already known for lighting and extinguishing at a distance gas-lamps, and particularly the lamps of a town, from a central position, according to which at each lamp site in a district or group there is a relay which is controlled by the relay of the preceding lamp in the group, and itself actuates the relay of the succeeding lamp in such a manner that a controlling device at the central position causes successively the operation of the relays at all the lamp sites—that is to say, the lighting or extinguishing of all the lamps of the district.

Their invention relates to an electro-mechanical relay of the type referred to, which is characterized more particularly "by the simplicity of its mechanism and its reliable operation, and which requires only a very feeble current." The relay comprises a number of independent and successive contacts, which, at fixed moments and in desired order, permit the series of separate operations necessary for controlling the lamps—namely, the opening of the gas-valve, the lighting of the burner, and the closing of the gas-valve—as well as actuating the relay at the next lamp site.

Another characteristic feature of the invention is that each relay (which comprises an independent source of electricity) is arranged in the general circuit in such a manner that the starting of this relay puts into circuit the sources of electricity of two succeeding lamps only, whereby the use of a central battery is obviated, and allows of the use of conductors of very small section between the lamps.

APPLICATIONS FOR LETTERS PATENT.

9956.—Crowe, H., "Gas-engines." April 25.
9972.—Pitts, S. T., "Gas-making machine." April 25.
10,013.—Lake, W. E., "Igniting device." [A communication from S. Rothmüller.] April 25.
10,049.—L'Aster (Société Anonyme), "Water-meters." April 25.
10,053.—Wright, W. H., "Concentrators for ammonia." April 25.
10,055.—Williams, J. B., "Mantles." April 25.
10,139.—Glover, T., "Back for gas-stoves." April 26.
10,140.—Glover, T., "Gas-heating stoves." April 26.
10,184.—Mitton, A. E., "Inverted burner fittings." April 27.
10,211.—Langdon-Davies, W., "Pressure-gauges." April 27.
10,228.—Eastick, S. P., "Generating gas and obtaining salts as bye-products." April 27.
10,285.—Anderson, H., "Arrangement for lighting gas from a distance; and gas-tap." April 28.
10,291.—Rock, W. S., "Gas cooking-stove." April 28.
10,308.—Edwards, A. N., "Pneumatically-operated gas-valves." April 28.
10,325.—Bronder, G. A., "Gas manufacture." April 28.
10,448.—Parry, H. E., "Gas-lamps." April 29.

Unexpected Discovery of Natural Gas in Russia.—The "Journal Industriel et Commercial" of St. Petersburg gives the following story of a large industrial undertaking founded on a chance discovery of an escape of natural gas. Some time ago, a landed proprietor in the Novo-Ouzensky section of the Samara Government was boring an artesian well on his estate. To his great surprise, instead of water, he found gas emanating from the well. The enterprising landowner turned this to account. He established on his estate large glass-works and a flour mill, in each of which the natural gas is used for both heating and power purposes.

Gas-Fitters and Municipal Trading.—Speaking last Tuesday night, at a meeting of the Birmingham and District Ironmongers' Association, Mr. J. Thacker (President of the Birmingham Association of Master Gas-Fitters) said the Gas Department of the Corporation was a monopoly which touched the gas-fitting trade in particular, but also the ironmongers and plumbers. The Master Gas-Fitters' Association, started about six years ago, commenced with the idea of "squashing" the Gas Committee. They fought very hard, and perhaps indiscreetly at the beginning; and he was told afterwards that diplomacy would perhaps be the better way to get better results. Seeing that the fighting attitude did no good, the Association resorted to what might be called "diplomatic action." This had proved successful; and the Association thought now that this was the way to deal with municipal trading. The Gas Committee, he believed, would more and more give out to the trade the work they got. He admitted, however, that the trading of the Gas Committee rather hit the ironmongers.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills read a second time and committed: Bicester Urban District Gas Bill, Blackburn Corporation Water Bill, Chesterfield Gas and Water Board Bill, Chichester Gas Bill, Gaslight and Coke Company's Bill, Ipswich Corporation Bill, Marple Urban District Council Gas Bill, Tamworth Gas Bill, Weston-super-Mare Gas Bill.

Bill reported, with amendments: Harrogate Corporation Bill.

Bill read the third time and passed: Chester Water Bill.

The following Bills to confirm Provisional Orders made by the Board of Trade under the Gas and Water Works Facilities Act, 1870, were presented on Monday last week, read the first time, and referred to the Examiners:

No. 1 Bill—Alfreton, Barnstaple, Burnham, and Launceston Gas Orders.
No. 2 Bill—Cannock Chase, Clay Cross, Hythe and Sandgate, Lichfield, and Whitney and District Gas Orders.
No. 3 Bill—Holyhead, Llangefni, Llanrwst, and Pwllheli Gas Orders.
No. 4 Bill—Busby and District, Longford, Preston, and Uxbridge Gas Orders.
Gas and Water Orders Bill—Blandford Water, Guisborough Water, North Pembrokeshire Water and Gas, Sheringham Gas and Water, and West Gloucestershire Water Orders.

The Duke of Devonshire has presented a petition against the Chesterfield Gas and Water Board Bill.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Bill brought from the Lords, read the first time, and referred to the Examiners: Chester Water Bill.

Bill read a second time and committed: Local Government Provisional Orders (Gas) Bill.

Bills reported, with amendments: Chasetown Gas Bill, Gloucester Corporation Bill, Luton Water Bill [Lords], Swinton Urban District Council Bill [Lords], West Cheshire Water Bill, Wirral Water Bill.

The Middlesex County Council have withdrawn their petition against the Enfield Gas Bill [Lords].

ENFIELD GAS BILL.

Opposition by the Middlesex County Council.

The Bill promoted by the Enfield Gas Company was last Thursday before the Court of Referees—Mr. Whitley presiding—on the petition of the Middlesex County Council for *locus standi* to be heard against the measure. The petitioners' *locus* was objected to by the promoters.

Mr. Tyldesley Jones appeared to support the *locus*; and Mr. Blennerhassett, K.C., represented the Gas Company.

Mr. Tyldesley Jones said he appeared for the Middlesex County Council in support of their *locus*. The Bill was promoted by the Enfield Gas Company; and the existing Company was authorized by three Acts of Parliament to supply gas in various parts of Middlesex. The Bill proposed to confer power on the promoters in regard to capital, the breaking up of streets, and for altering the provisions at present regulating the relations between the Company and their consumers. The Middlesex County Council objected in the first place to further capital powers, also to the alteration of the position as between the Company and their consumers. Objection was taken to the breaking-up of streets; and the Council asked for further protection in respect to the exercise of powers under existing Acts. The promoters conceded *locus* as against clause 34 of the Bill, which conferred power to break-up the streets. He claimed general *locus* under Standing Order 134 B, as a County Council. He alleged that the Bill would injuriously affect the county. He also claimed *locus* against the provisions altering the position as between the Gas Company and the consumers—first, because he was a consumer, and a substantial consumer; but he also claimed *locus* because he represented the gas consumers generally. The local authorities were not opposing the Bill; and this was a matter which the Court had taken into consideration in previous cases.

Mr. Moon (Speaker's Counsel): The local authorities do protect the rights of gas consumers.

Mr. Tyldesley Jones: That is so; and if the local authorities are opposing, the Court would not, as regards the consumers' interests, give me *locus*.

Mr. Moon: But the converse does not apply.

Mr. Tyldesley Jones remarked that they were not correlative, perhaps; but it was a matter which the Court had taken into consideration. He claimed that he ought to be given discretionary *locus*. First of all, he claimed to be a gas consumer. His petition stated that he was the Education Authority responsible for the management of certain schools throughout the county, and also schools within the area of supply of the Company which depended on the gas supply. He also alleged that the present price was excessive, and that the standard price should be reduced. He quoted the Basingstoke Gas Bill, which incorporated with parliamentary powers a Company who hitherto had been carrying on business. The petitioners consisted of ten persons; and it was held that they were entitled to be heard as gas consumers. That was a case of gas consumers claiming *locus*, and who obtained

it, because the local authority did not represent the consumers. Because they were affected, they were entitled to be heard.

Mr. BEALE (a Member of the Court): But here you are claiming special terms for yourself.

Mr. TYLDESLEY JONES: I quite agree; but I am also claiming that the standard price should be reduced. I quite agree *locus* might be refused to a small consumer.

Replying to further questions, Counsel said he could not say what was the proportion of their consumption. They had exactly the same petition in the House of Lords. They did not give any evidence there as to their consumption. They asked the Lords' Committee that their schools might be treated as one consumer.

Mr. MOON: You have not so far said what your consumption is?

Mr. BLENNERHASSETT: The total annual sale is 217,000,000 cubic feet. The County Council consume 356,000 cubic feet—a fraction of 1 per cent.

Mr. TYLDESLEY JONES said that as a substantial gas consumer he claimed *locus*. Inasmuch as the local authorities were not there looking after the interests of the consumers in the district, he claimed that his *locus* should be conceded, to allow him to look after the interests of the gas consumers generally.

Mr. MOON: Are you a lighting authority?

Mr. TYLDESLEY JONES replied that he was not; but the local authorities were lighting authorities. In respect to the ordinary consumers, he held he was in the position of the local authorities themselves.

The CHAIRMAN: What are the chief municipal authorities in your area of supply?

Mr. TYLDESLEY JONES: I suppose they would be the Enfield, Edmonton, and Southgate Urban District Councils. I am told they all have Electric Lighting Orders. Therefore they have no interest in seeing that the gas consumers are looked after. Apart from this claim, I ask for my *locus* under Standing Order 134 B. The petition alleges that the existing provisions in respect of the breaking-up of streets are quite insufficient as a protection. I do allege injury to the county in this matter; and under Standing Order 134 B the Court can give me *locus*. I cannot, of course, claim *locus* in respect of this matter on the ground of further capital powers; but what I can do is to ask the Court to confer my *locus* in order that I may raise the question of insufficient provision for the protection of the county roads and bridges. This was the main point fought in the House of Lords; and in this respect no objection was taken to our *locus standi* before the Lords Committee. As a result of negotiations, certain concessions were made for the protection of the Middlesex County Council; and they are embodied in clause 42 of the Bill.

Mr. BLENNERHASSETT: Every provision we opposed was thrown out.

Mr. TYLDESLEY JONES: That is quite right; but we asked for certain protection and got it by clause 42. This clause does not extend to the exercise of the existing powers to break-up streets; and it is in respect to this that I ask for discretionary *locus*.

Mr. MOON: Where do you find any additional power in the Bill?

Mr. TYLDESLEY JONES said there was nothing in the Bill which conferred further powers in respect of streets. But it did confer on the Company further capital powers; and these powers, of course were necessary to enable them to lay down further mains and break up the streets. If they did not get these capital powers, they would not be able to break up the streets and execute other works. He asked for unrestricted *locus* against the Bill.

The CHAIRMAN, after the Court had conferred for a few minutes, said the Court could not allow *locus* in this case.

Mr. TYLDESLEY JONES: Except so far as is conceded by the promoters?

The CHAIRMAN: Certainly.

Mr. MOON: That is against clause 34?

Mr. TYLDESLEY JONES: Yes.

This concluded the proceedings.

Clause 34 reads as follows:

The Company may lay down, repair, take up, alter, relay, and renew mains, pipes, and culverts within the limits of supply for the purpose of procuring, conducting, or disposing of any oil or other materials used by them in, or resulting from, the manufacture of gas, or any residual products thereof, or for any purpose connected with their business, and the provisions of the Gas-Works Clauses Act, 1847, with respect to the breaking-up of streets for the purpose of laying pipes and for the protection of pipes when laid, so far as they are applicable for the purposes of this section, shall extend and apply *mutatis mutandis* to and for the purposes thereof.

It is against this clause that the *locus* of the Middlesex County Council is allowed.

CHASETOWN GAS BILL.

This Bill came before the Unopposed Bills Committee of the House of Commons last Thursday—Mr. WHITLEY presiding.

Mr. W. M. BELL, the Parliamentary Agent, explained that the Bill was to reincorporate the Company and to confer upon them the usual statutory rights. The measure was at first opposed by the Lichfield Gas Company, with whom questions of overlapping in the area of supply had arisen; but the two Companies had since come to an agreement. The area of the Chasetown Company's supply had been reduced, and the additional capital asked for cut down proportionately. The present capital was £2500, with £700 mortgage; and the Company now asked for £12,400 of additional capital to extend the undertaking, as there was a good deal of scope in the district.

In answer to questions put by the CHAIRMAN, Mr. Bell pointed out that the Lichfield Company could scarcely be expected to meet the needs of Chasetown, as Lichfield was 4 miles away. It was true that, although they were on the coalfields, they proposed a maximum price of 5s. per 1000 cubic feet. But the local coal was not the best for gas purposes, and they had to go to Sheffield—100 miles away—for coal. Lichfield had a maximum price of 5s. The Chasetown Company did not want to charge their maximum price if they could avoid doing so.

The Bill was ordered to be reported to the House.

GAS-MAINS ON THE PROPOSED ST. PAUL'S BRIDGE.

The Select Committee of the House of Commons presided over by Mr. Mooney last Tuesday passed the preamble of the Corporation of London (Bridges) Bill, the consideration of which was commenced the previous Thursday. The inquiry is of interest to readers of the "JOURNAL" from the fact that petitions against the Bill had been presented by the Gaslight and Coke and South Metropolitan Gas Companies, who, it was thought, would be prejudicially affected by a clause of the Bill, under which persons were to be prohibited from laying down mains or pipes, or executing any work upon the proposed new bridge leading up to St. Paul's, without the consent in writing of the Corporation, and in accordance with such terms and conditions as they might determine. The Companies urged that the exercise of the powers sought by the Corporation would in certain cases result in their mains and pipes being exposed to risk of injury from various causes, or being left at so great a depth below the surface of the roadway as not to be accessible, except at greatly increased cost and inconvenience. The Companies submitted that, in view of the possibility of arrangements being come to at some future time with other companies for the supply to each other of gas in bulk, in order to enable them to meet emergencies, it was expedient, in the public interest, that they should have full facilities for laying mains across the new bridge. In the petition of the South Metropolitan Gas Company, fear was expressed that the demolition of the houses on a large area of land in Southwark, in which the Company had installed prepayment meters, fittings, and other appliances at great expense, would deprive them of revenue, and render useless the capital they had expended.

Mr. Balfour Browne, K.C., and Mr. Clode appeared in support of the Companies' allegations.

In dealing with the petitions, Mr. Honoratus Lloyd, K.C., on behalf of the Corporation, explained that the clause to which exception had been taken was put into the Bill for the express purpose of preventing the bridge being subject to constant interference by the roadway being broken up practically without the Corporation having anything to say in the matter. The clause had been inserted in other Acts; and it was necessary for the protection of the bridge and the public. The Bill provided for all work being done with the least possible inconvenience; and every care would be taken to inflict as little injury as possible upon anybody. If it could be shown that the petitioners' interests had been neglected, the promoters would be pleased to consider protective clauses.

When the clauses of the Bill were under consideration on Thursday, Mr. Balfour Browne announced that the petitioners' requirements had been satisfied to some extent by their being afforded reasonable accommodation for their mains on both the Southwark and the new bridge, on payment of an annual wayleave. The Companies could also, if they desired, carry out the work incidental to the making of the approaches to the bridges, and charge the Corporation with the cost; and their workmen were to have the right of access to the mains and pipes in any street or road temporarily closed. On behalf of the South Metropolitan Gas Company, Counsel put forward a claim for compensation for loss of revenue in the event of the Corporation clearing the site in Southwark referred to in their petition. He cited two precedents, in support of the claim. It was, however, opposed by Mr. Honoratus Lloyd; and the Committee declined to allow it.

METROPOLITAN WATER BOARD (NEW WORKS) BILL.

The Joint Committee of both Houses of Parliament, presided over by the EARL OF KINTORE, resumed the consideration of the above-named Bill on Monday last week.

Mr. BALFOUR BROWNE, K.C., said the promoters had reconsidered their position in the light of the decision of the Committee to strike out reservoirs Nos. 1 and 2. With the permission of the Committee, they would withdraw the proposals for the intake, the channel (cut No. 1), to which objection was taken by the London and South-Western Railway Company, and reservoirs Nos. 3 and 4. He asked the Committee to sanction reservoir No. 5 (adjacent to the existing reservoirs), because it could be supplied from the present intake, and reservoirs Nos. 6 and 7, for which a new intake would have to be considered.

The CHAIRMAN said there remained the question of the 140 million gallons.

Mr. BALFOUR BROWNE said upon this matter the Thames Conservancy did not ask for modification. The Water Board were quite determined to get storage to the amount of 27,000 million gallons, and the 140 millions would remain part of the bargain.

Mr. VESEY KNOX, K.C., said the Conservancy would be content that the Bill should pass, relying upon the Water Board to apply to Parliament for sites for future storage not open to objections urged against the present proposals.

Mr. PAGE, K.C., said the statement from the promoters removed the opposition of the Railway Company.

Objections on behalf of various local authorities and others were then heard; and a conference was suggested, with the view of the parties coming to an arrangement.

On the re-assembling of the Committee on Tuesday morning,

Mr. BALFOUR BROWNE said an agreement had in substance been arrived at upon a clause to provide that the daily average quantity of water to be taken, diverted, or impounded from the Thames should not exceed 230 million gallons on any year, unless or until the Board should have obtained power to construct storage reservoirs in addition to any such reservoirs which may be authorized to be constructed during the present session. The principle of the clause was that the power of the Board to take water from the Thames was restricted until storage was provided—there was no measure of storage. The Board were content to be bound by the smaller figure of 230 million gallons; and reservoirs Nos. 5, 6, and 7 would carry them on probably until 1928. But long before that, it would be the duty of the Board to go to Parliament with a scheme including probably a new intake, and very much

larger reservoirs, giving the 27,000 million gallons storage necessary for full abstraction from the Thames.

The room was then ordered to be cleared to allow of the Committee conferring in private. On the re-admission of the parties,

The CHAIRMAN said the Committee shared in the general desire that the unrestricted right of the Water Board to take water at all states of the river should cease; but as, by agreement between the Board and the Conservancy, the maximum average daily take was reduced from 300 million gallons to 230 millions, the latter amount could without difficulty be obtained without at present—and he emphasized "at present"—reducing the minimum flow over Teddington Weir to the 140 million gallons asked for. In the Committee's view, this minimum should be fixed at 170 million gallons, subject to an emergency right to draw it down to 140 millions with the consent of the Local Government Board. Unless parties saw their way to accept the figures, the Committee would be unable to allow the Bills to proceed.

Mr. BALFOUR BROWNE asked for an interval to allow the Water Board to consider this decision, and

The Committee adjourned to yesterday.

At the meeting of the Thames Conservancy on Monday last week, the Chairman (Lord Desborough) said he lamented the exclusion by the Committee of reservoirs Nos. 1 and 2 from the Water Board's Bill. The Board had agreed to enlarge the flood discharge at Staines Bridge, and they were also going to make a cutting through the bank. Now that these reservoirs were to be excluded from the Bill, the Chairman did not see how the Conservancy could ask the Board to spend the large sum of money involved. The rejection of the reservoirs also involved the loss of water storage, which was a serious matter.

LEGAL INTELLIGENCE.

DEFINITION OF FIRE-CLAY.

In the House of Lords, a few days ago, the Chancellor and Lords Macnaghten, Shaw, and Robson, heard an appeal by the Caledonian Railway Company, in which they sought to interdict the respondents, the Glenboig Union Fire-Clay Company, Limited, from working beds or seams of fire-clay or clay in the lands of Gartverrie and Ramoan, underneath or adjacent to the Castlecary and Garnkirk branches of the appellants' railway near Glenboig Station. The question for decision was whether the beds and seams of fire-clay, of which the respondents are tenants, are, in so far as they are situated in the lands acquired by the appellants, to be deemed to be excepted out of the conveyances in favour of appellants as falling within the exception of mines of coal, iron, stone, slate, or other minerals under lands purchased by them within the meaning of section 70 of the Railway Clauses Act, 1845.

Mr. Clyde, K.C., Mr. F. T. Cooper, K.C., and Mr. W. Watson appeared for the appellants; Mr. Scott Dickson, K.C., and Mr. Macmillan represented the respondents.

The appellants submitted that the fire-clay in question was not a mineral within the meaning of the Act, inasmuch as it is a common rock of the district, and forms the substratum of the soil with probably other kinds of rock intermixed. They further submitted that the fire-clay is part of the subjects purchased by them when they acquired the lands. The respondents, on the other hand, maintained that fire-clay is a mineral within the meaning of the Act, and that the fire-clay in question is excepted from the conveyances in favour of the appellants. The Lord Ordinary refused the interdict; and the First Division of the Court of Session upheld this decision. The appeal was against these judgments.

In giving judgment at the conclusion of the arguments by Mr. Scott Dickson for the respondents, the Lord Chancellor said the case was one of a class which always had been, and, he supposed, always would be, of exceptional difficulty, as would other cases be in which the decision really depended upon a question of degree. The particular seam now being worked, to which alone the present decision would apply, was certainly of an exceptional character as to its properties and value, and it was not established in the evidence before the Court that it was present in such large proportions as to destroy that exceptional character. His Lordship moved that the appeal be dismissed.

Lords Macnaghten, Shaw, and Robson concurred; and the appeal was dismissed, with costs.

Mr. E. O. Preston's Bankruptcy.—At the London Bankruptcy Court last Friday, an application was made to Mr. Registrar Linklater for an order of discharge on behalf of Mr. Edward Oxenford Preston, financier, carrying on business at No. 4, Tokenhouse Buildings, E.C., as Messrs. E. O. Preston and Co. Mr. W. Boyle (the Official Receiver) reported that the applicant failed last October. Proofs to the amount of £49,751 had been received; but the Trustee was unable to state what proportion of the claims was likely to be ultimately admitted. The assets, valued by the bankrupt at £3115, were not likely to realize more than £705; and, in the most favourable circumstances, the dividend was not likely to exceed 6d. in the pound. It will be remembered that the applicant, in the course of his business, promoted various undertakings, chiefly for the supply of gas and water. Up to 1900, he made between £8000 and £10,000 a year; but about five years ago, owing to the failure of several promotions, he incurred large liabilities, which now ranked against his estate. Mr. Page, on behalf of the bankrupt, said his client was prepared to find £750 within a reasonable time; and he asked for an order to be granted upon these terms. His Honour said the bankrupt had been speculating on a very large scale, and had, further, been extravagant in his expenditure. He could not be allowed to buy his discharge in the manner suggested by Counsel; and there must be a suspension of three years from the examination in January.

MISCELLANEOUS NEWS.

MEETING OF SULPHATE OF AMMONIA MANUFACTURERS.

At the Chief Offices of the Gaslight and Coke Company, Horseferry Road, S.W., on the 28th ult., a meeting of upwards of sixty manufacturers of sulphate of ammonia—including many representing annual makes of 10,000 tons and upwards—was held to discuss questions bearing upon the extended utilization of this material. The following is a condensed report of the proceedings, which were private.

On the proposition of Mr. T. Milne, the Chairman of the Sulphate of Ammonia Committee, Mr. D. Milne Watson, the General Manager of the Gaslight and Coke Company, presided.

The Chairman, in opening the proceedings, expressed regret at the absence of the Governor of the Company (Mr. Corbet Woodall). As large manufacturers of sulphate of ammonia, he said, the Company welcomed those present. The meeting last year was a very great success, and resulted in many conversions to the cause of sulphate, and a considerable augmentation of the funds of the Committee; and he hoped similar results would follow that day's meeting. It was a great pleasure to welcome the representatives of America, Belgium, France, and Germany. There were two delegates from America (Mr. M'Ilravy and Mr. Pierce); and Mr. Sohn and Mr. Kirkpatrick were again with them. M. Lemaire, representing France, was present for the first time. He then asked Mr. Milne to address the meeting.

Mr. Milne began by explaining the working of the Committee, the object of which was, he said, propaganda pure and simple—to spread on all sides information about sulphate of ammonia and the best way to use it, and practically to prove to consumers that it was the best nitrogenous fertilizer extant. They paid no particular attention to prices, as their work was to create a demand for the article; and they could then leave the rest to the sure action of supply and demand. They had in the past printed and distributed large quantities of literature, had fitted up stands at agricultural shows, and given prizes to agricultural competitions all over the country—a condition being that not less than 1 cwt. of sulphate of ammonia per acre should be used in the manure mixtures. In many other ways they had furnished information about their article. They cordially welcomed the representatives from the United States, Belgium, France, and Germany. He looked with positive envy at the work of their friends of the three Syndicates, because here in Great Britain they were consuming only a beggarly 80,000 to 85,000 tons of sulphate of ammonia annually for all purposes, not more than 70,000 tons of which was used in agriculture, and yet in Germany alone they increased the consumption last year by about 80,000 tons. The Committee felt the good of last year's meeting, inasmuch as immediately afterwards makers representing about 12,000 tons joined them. He appealed to all present to help in bringing new subscribers. Turning to the position of sulphate of ammonia, he said the increases last year were as follows: Germany, 50,300 tons; Great Britain, 21,000 tons; and the United States, 26,000 tons. The total increase in the United States and the near Continental countries was 106,000 tons. This was a large quantity for which to find outlets; and if they did not find them, it would act as a dead-weight on the market, and spoil prices all over the country. He claimed for propaganda that it had prevented, and would again prevent, such a position arising. Let each one present get hold of a maker not subscribing, and bring him in. Let them also arrange to give lectures to farmers all over the country; and if they knew of any who would take up experimental plots, they should be helped to do so. These plots were the Committee's sheet-anchor. They had about 1600 in all parts of the country; and there was really no reason why next year they should not have 3000. Let them give the Committee encouragement to go on by providing the money, and they would have good work done for them—work which would repay them well. They must help sulphate to stand against its growing competitors by making the very best article possible. He urged the managers of country gas-works always to keep plenty of sulphate for local farmers, and not sell it all for export. In conclusion, he again emphasized the value of propaganda work, and made a further appeal for funds to enable the Committee to carry it on effectively. He pointed out that Germany paid for this work 2s. 9d. a ton on all her production of sulphate, against England's 7d. per ton on 220,000 tons out of 370,000 tons; and that as a consequence Germany used 350,000 tons against England's meagre 70,000 tons.

At the request of the Chairman, Mr. M'Ilravy, of the American Coal Products Company, then addressed the meeting. He expressed his great pleasure at being once more present, especially as it was under much more favourable circumstances than obtained last year. He said the production of sulphate of ammonia in the United States and the development of its use as a fertilizer was attended by a number of peculiar conditions that should be taken due account of in any careful discussion of the subject. It was his intention to state these briefly, and touch upon the effect they might be expected to have on their progress and the means they had adopted for dealing with them. The future large production of ammonia in the United States might be expected to come from the bye-product coke-oven, and not from the coal-gas industry. The recent tendency of the steel industry lay towards the West, because of the supplies of iron ore available on the Great Lakes, which had resulted in the building of the large plants at Buffalo, Detroit, Joliet, Garry, Milwaukee, Duluth, and Sault Ste. Marie—the latter just over the Canadian line. It therefore seemed certain that the centre of bye-product coke production, and therefore of sulphate of ammonia recovery, would be in the vicinity of Chicago. The chief interest of this fact to them was that they had to consider the disposal of the sulphate as well as its production. The consumption of commercial fertilizers in the United States for the year 1910 was estimated at nearly 6,000,000 tons, valued at $126,000,000. The area in improved farm land, according to the census of 1900, amounted to 414,800,000 acres. Therefore the American farmer applied a little less than 3 lbs. of commercial fertilizer per acre to his land. Four States—viz., Georgia, North and South Carolina, and Alabama—used

50 per cent.; and the adjacent States of Florida, Mississippi, and Louisiana brought the total up to 58 per cent. of the whole quantity of artificial fertilizers used in the States. Yet the only accessible source of domestic sulphate of ammonia supply to these seven States, which had an area greater than that of the whole of the German Empire and Austria together, was the bye-product coking plants near Birmingham (Ala.), at the lower end of the Appalachian coal region. The plants erected at Chicago were about 700 miles away, and freight cost infinitely more than the sea freights from England and Germany to the Atlantic and Gulf Ports. He drew attention to this fact to show that there was no competition worth mentioning to fear from the domestic supply. Were the seven States mentioned to use sulphate in all their mixed fertilizers, in accordance with the familiar formula of 200 lbs. to the ton of mixed manure, they alone would consume 350,000 tons of sulphate yearly. The speaker then proceeded to consider at some length the conditions prevailing in the States near Chicago, the assumed geographical centre of sulphate of ammonia production. Continuing, he said it had been necessary to overcome the handicap that the disposal of sulphate of ammonia had been labouring under because of the distance of the most advantageous market and the relative lack of near consumption. Owing to the general use of ready mixed fertilizers by the American farmer, and to the long campaign of education necessary to bring him to buy and mix the single ingredients for himself, no special effort had yet been made to promote the retail demand. The advantages of using sulphate of ammonia had been well explained to the manufacturers of mixed fertilizers; and the entire domestic production had been disposed of to them. No difficulty whatever had been experienced in its use; and, in fact, it was rapidly coming to be preferred as a carrier of nitrogen. The satisfaction that fertilizer manufacturers had felt with the results of sulphate of ammonia was reflected in the increasing demand and advancing price for the imported article. But their efforts to prepare for the future had not stopped there. The United States had an extremely well-organized and extensive system of agricultural experiment stations. There was one in each State and territory of the Union; and in some States there were as many as three—the total being 63. In addition to this, there was an Agricultural College in each State, in some cases located at the experiment station, in others elsewhere. The experiment stations frequently had several outlying demonstration farms or sub-stations under their control; and in some States—notably Virginia, Alabama, and Georgia—there was a complete system of secondary agricultural schools tributary to the Agricultural College. In addition to these two organizations, the United States Government maintained a very extensive research department known as the Bureau of Plant Industry, which conducted tests and investigations along certain lines, frequently co-operating with the experiment stations. Working through the directors of the various stations east of the Mississippi, and some of those west of it, they had elicited the support of most of them in their propaganda. Many of them had included sulphate of ammonia in their scheme of experiments; and they were regularly supplied with sufficient for their purposes. As a result of this work, bulletins had been published giving the results of successful tests of sulphate of ammonia and advocating its use. Where formerly no mention was made of it, sulphate was now receiving its share of attention. The same line of approach had been followed with the separate agricultural colleges; and many of them had found a place for experiments with sulphate of ammonia as a part of their farm demonstration work. The secondary agricultural schools had been enlisted in the same manner, by suggesting experiments, donating the fertilizers, and in some cases paying part of the expenses involved. The matter of farm demonstration had been taken up on a much more extensive scale this year. In conclusion, the speaker gave the following statistics: In 1901 the imports of sulphate of ammonia were about 14,500 tons; in 1907, they were 34,000 tons, or more than double; and last year they were 63,000 tons—practically doubled again, and in only three years. These figures were for the financial year ending June 30. To show the rate of increase now going on, Mr. M'Ilravy gave the figure for the year ended Dec. 30, 1910, which showed 83,000 tons imported; the great increase being in the preceding six months. He said that while this increase in consumption had been going on, the price had risen from $52 per net ton, which was quoted a little more than a year ago, to $60 or upwards. The advance in price and in demand, and the promise that these developments gave for the future, might fairly be claimed as the result of their propaganda.

The next speaker was Mr. Sohn, who is Director of the Deutsche-Vereiniging Ammoniak-Verkaufs. Before dealing with the question of propaganda work, he referred to the production, sale, and conditions of price of sulphate of ammonia in the past few years. The production in 1909 was 950,000 tons; whereas in 1910 it was 1,062,000 tons—an increase of 112,000 tons, or upwards of 11 per cent. In Germany, the consumption in 1910 was 80,000 tons more than in 1909. This was not attained without considerable effort and the expenditure of large sums of money. In conjunction with the Oberschlesische Kokswerke und Chemische Fabriken Aktien-Gesellschaft, of Berlin, they had spent for propaganda purposes during last year 938,577·36 marks, which came to 2s. 7½d. per ton of the total quantity of 352,762 tons of sulphate delivered by the two Companies. Their propaganda expenses increased in 1910 as against 1909 by about 8½d. per ton delivered, inasmuch as in the latter year they were only 444,915·08 marks, or 1s. 11d. per ton of the entire quantity of 227,345 tons of sulphate delivered. In 1908, they were 9½d. per ton; and in 1907, 6d. per ton. Though the extension of the propaganda activity in Germany had proceeded from necessity, it had had a beneficial influence on the entire market position of sulphate of ammonia. They would not, however, be able to go much farther; but they had no anxiety as to being in a position to place in Germany the whole of the quantities of sulphate to be produced there within a conceivable time, as only through their propaganda had they obtained an idea as to the great extent to which this product could be used with advantage in agriculture. He was convinced that when similar arrangements were made in England to those obtaining in Germany, English makers would certainly within a few years be able to place a large part of their production in their own country. They would thereby obtain a double advantage. They would first of all develop their agriculture—*i.e.*, increase its activity—and, by means of the furtherance of the general interest, make it more profitable; and, secondly, possess a firmer basis for their sales, as against the overseas countries. It must not be forgotten that the production of sulphate of ammonia would continuously increase by considerable quantities, and that therefore it would always be necessary to open up fresh fields for its disposal. He thought he should not be considered unreasonable if he said that the propaganda expenses for the different countries should not be borne by those countries individually, but that all producers of sulphate of ammonia should bear an equal share. He thought it would be admitted that the great expenditure made by them in Germany had assisted in placing the sulphate market in an extraordinarily favourable position. Consequently, he might hope that the value of the expenditure was generally acknowledged, and that everyone was prepared, from the advantages assured in this way, to bear his share of the absolutely necessary expenses. He referred again to the conditions of the sale of sulphate in former years and to what had been achieved by propaganda, and concluded by appealing to all present to place at the disposal of their Committee the necessary funds to carry it on, as was done in America, France, Belgium, and Germany, and ensure the ready disposal at a fair price of even a largely-increasing production.

Mr. Kirkpatrick, who was then called upon by the Chairman, said that at this time last year the position was very different from what it was now. The spring season had ended with rather important stocks in Germany, France, and Belgium; and prices were much lower than at present. It was decided to carry on propaganda work more energetically, and to make united efforts to get the article known and extend its consumption. This had been done everywhere; and the results obtained were known by the present splendid position of the article. There must be no hesitation in maintaining propaganda work; and he ventured to ask that more money should be placed at the disposal of the International Committee for international work. Belgium could not have a very great influence on the sulphate market of the world, owing to its small annual production; but it set a good example by being at the top of the list of consumers of sulphate per acre of land. Demonstration and experimental fields, lectures, newspaper articles, pamphlets, posters, &c., were the means of propaganda. The special pavilion of the Sulphate of Ammonia Syndicate at the Brussels Exhibition attracted much interest; and the Jury granted the Syndicate the highest award—the *Grand Prix*. Most of the numerous lawns and gardens had been manured with sulphate, and aroused the admiration of visitors. The Belgian Syndicate spent over £4000 (1s. 10d. per ton) on propaganda last year. It might be thought that the present state of the market would justify a relaxation of the efforts to extend the consumption of sulphate—the demand being very great, and in some cases larger than the production. He believed, however, that this would be a great mistake. It was their duty to hold their position; and this could only be done by maintaining and extending the propaganda work. The nitrate of soda makers spent far larger sums, and were jealous of the favour accorded to sulphate of ammonia.

The opinion was expressed by Mr. Peter Dunn that something would have to be done to dispose of the extra productions coming on to the market. He would be glad to hear from Mr. M'Ilravy what was the extra quantity they were likely to produce in America from now onwards. He also asked Mr. Sohn whether the great increase in the consumption of sulphate of ammonia had been brought about to the detriment of nitrate of soda. Mr. M'Ilravy replied that the United States might be expected to produce 20,000 to 25,000 tons more per annum for the next few years. An increasing quantity of nitrate of soda was also imported into the States. Mr. Sohn said that the increased consumption of sulphate of ammonia in Germany had not been detrimental to the use of nitrate of soda; but the consumption of nitrate of soda had remained steady for the last ten years, at about 450,000 tons a year, about one-third of which was used for industrial purposes, and the rest in agriculture. The consumption of sulphate of ammonia in Germany ten years ago was about 80,000 tons; while it was now about four-and-a-half times this quantity. This result would not have been obtained without pressing its use on agriculturists.

Mr. Charles Carpenter remarked that the Committee had an enormous advantage in possessing so able a Chairman as Mr. Milne, who came into contact with Mr. Sohn, and got from him much of the enthusiasm to which Mr. Sohn had given expression. Advertising was the essence of the Committee's business; and it was remarkable so little had been done in the past in advertising. They knew now that it was necessary to make a good article, and also to teach people how to use it. He would like to emphasize what Mr. Milne had said about keeping up the purity of sulphate. The meeting that day was to speak to the non-subscriber, and to induce the contributors to do more than they had hitherto been able to do. It was difficult, whatever one might wish, to know how to carry this out. One way had occurred to him, and he gave the suggestion for what it was worth. It would at least show that the South Metropolitan Company, as large makers of sulphate, recognized and supported what Mr. Sohn had said. They contributed 7d. per ton to the Committee for what was called propaganda work; and they were perfectly prepared to increase the subscription to 2s. 6d. per ton. It struck him that there might be others of the same opinion; and perhaps if they did subscribe a larger sum they would be more likely to bring others into the fold by this expression of their earnestness. The South Metropolitan Company were prepared to increase their subscription to 2s. 6d. per ton, or even to 2s. 9d. per ton, whenever the Committee asked them.

At this point, Mr. Milne said he should perhaps have added to his opening statement that they were already working hand in hand with their friends abroad; and the Sulphate of Ammonia Committee now subscribed £2000 a year to the common fund. But this was only a drop in the ocean. Their work was so much greater. In addition, the Committee spent £500 a year in Spain on their own account, as they thought they would like to gain some experience of their own in propagandist methods abroad.

Attention was called by Mr. Charles Page to the unscientific method of selling which was adopted by many sulphate manufacturers in this country. No doubt, he said, a large number of makers were quite unable to know when to sell; but this was a point on which the Committee could help them much. He drew attention to the difficulties arising from shipments made of sulphate in an inferior condition.

Mr. Bloxam, Scientific Adviser and Manager to the Committee, next addressed the meeting, and furnished some details of what had been done since the date of his appointment. He saw Mr. Sohn, and made himself acquainted with his methods. From Germany they had learnt much; and if they had five times the amount of money, they could try to imitate them. He was instructed to call on Professors of Agricultural Colleges; and this he did with much advantage. At first the colleges, not quite understanding the Committee's methods, looked askance; but later they became very helpful in the matter of supervisors for the experimental plots. As to Mr. Carpenter's statement that they wanted scientific advertising, they claimed in their advertising that, with the proper use of sulphate of ammonia, crops could be obtained twice as great as the average for the United Kingdom. Taking the average yield of potatoes for ten years as below 6 tons to the acre, in their agricultural competitions they had obtained 20 tons to the acre—this being the premier crop. In small plots last year they obtained 14, 11, and 12 tons of potatoes to the acre. They had one-tenth acre plots which yielded more than twice the average for ten years of the whole country. They possessed one feature which he believed the Germans did not—they offered prizes to Agricultural Societies for agricultural competitions. They offered prizes of £5, £10, and £15. One of the conditions of entry was that not less than 1 cwt. of sulphate of ammonia per acre should be applied. In former years, the Sulphate of Ammonia Committee had spent as much as £1000 for these competitions; but now they were falling off somewhat. The reason for this was that farmers considered they had now learnt as much as they wanted to know about roots. For potatoes, the Committee still had a strong demand, owing to the high prices obtainable for them. If, however, they wanted agricultural competitions to go ahead, they must go in for competitions in other crops—such as cereals, hay, permanent pasture, fruit, and hops. They must give the farmer a change; but there was the difficulty of harvesting such crops without losing a great part of them. They had friends in Agricultural Colleges who were working on cereal crops to show how they could be harvested economically; and no doubt the Committee would be allowed to proceed with competitions on a larger scale. Mr. Bloxam then gave particulars of the lectures which he delivered, and drew attention to the necessity for science and commerce to work hand in hand—remarking that at present it was too often the case that the two were dissociated.

Mr. Pierce said Mr. Sohn had really made a remarkable statement—that, with all the great industries of Germany, and the large production of sulphate of ammonia there, they were consuming all their sulphate in their own country. It seemed to him that the best thing for England would be to consume all her own sulphate of ammonia on British soil. He did not know that it could be done; but the experience of Germany appeared to indicate that it ought to be done. It was quite clear that they could not give up propaganda, because they had to look out for competition from nitrogen taken from the air.

In proposing a vote of thanks to their foreign friends for the information they had put before the meeting, Mr. Fraser remarked that the question of sulphate of ammonia was an international one. He was one of the earliest representing a large make to join the Committee; and for the first ten years he felt doubtful whether they were getting any value for the money spent. While, however, he was then doubtful of spending 4d. or 6d. per ton, he would now like to spend 2s. 6d.—not only for propaganda work in this country, but all over the world. If they spent sufficient money and thought on propaganda work at home, it would very largely increase the consumption. There would be a great increase in production over the whole civilized world; but when they considered the increased use of sulphate of ammonia, they need not have the least doubt that its position as the first artificial manure in the world could be maintained. He hoped their foreign friends would honour them with more visits in years to come.

Mr. Corbet Woodall said he felt that he had no right to ask to be allowed to second the resolution, because he had not had the pleasure of hearing the addresses of their foreign friends; but perhaps as Chairman of the Company on whose premises they were meeting, he might be allowed to say a few words in support of Mr. Fraser's proposal. Apart altogether from the special purpose that brought their friends there, they were heartily glad to see the representatives from foreign countries and from America present. On this particular occasion he knew how much they were indebted to these gentlemen for the lead given to help the Committee out of some of the older ruts in which they had been running, on to a broader plane. It did seem as if they were disposed to run their affairs on the lines of district councils or vestries, rather than on national or international lines. When they recognized how much their great industry owed to sulphate of ammonia, they ought, in his opinion, to do more than they had done in the past to make its advantages fully known. He heard that they spent on this propaganda work something like one-fifth of what was spent by their friends in Germany; and the results obtained seemed to be rather equivalent to the amounts of money spent in the two countries. Germany spent a large sum, and this country a small one; and then the makers had to come into competition with countries outside their own for that for which they ought to find a market here. He was surprised and gratified to see a gathering like this brought together; and remembering what Mr. Fraser had said about the inception of the Committee, its development was, to his mind, extremely satisfactory. He hoped that those who were doing their share to carry on this propaganda work would not be content until they had brought others in, so that, instead of half the makers, they would have the whole subscribing to the funds. He had much pleasure in cordially seconding the resolution.

The proposition having been carried with acclamation, Mr. M'Ilravy and Mr. Sohn acknowledged the vote, and added that if those present cared at any time to visit America and Germany, they would be only too happy to arrange similar meetings there, and to extend a hearty welcome to all. Mr. Kirkpatrick also expressed thanks, on behalf of M. Lemaire and himself, for the cordial welcome extended to them.

A vote of thanks to Mr. Milne Watson for occupying the chair was moved by Mr. Fyfe, who said there were many things in Scotland that he was proud of; but he was not proud of Scotland regarding the sulphate of ammonia business. They had wealthy businesses which were connected chiefly with the important iron industry; but scarcely one of these contributed anything towards the propaganda work which was so essential to the advancement of sulphate of ammonia. They had done all they could, and to one large firm had sent a deputation, but quite unavailingly. This operated in two ways. First, they were deprived of their own money; and, secondly, others said "So long as the largest ironfounders refuse to contribute, how can you expect us to do so?" It operated also in another way. Mr. Carpenter stated that he would contribute 2s. 6d. per ton. He (Mr. Fyfe) would be quite willing to go to his Board and say, "You ought to contribute 2s. 6d. per ton." They would reply, "Here is a small oil industry giving nearly £2000 a year, while there are important ironfounders giving nothing." He thought the first thing they must endeavour to do was to get, as a matter of common honesty, a number to join them. When this Committee started, sulphate of ammonia was about 30s. per ton below nitrate of soda on tonnage value. Now it was about £2 10s. per ton above it. Much of this was due to propaganda work—he did not say their own, but, indeed, largely due to the propaganda work of the gentlemen who were their guests. While they had all sympathy with everything that Mr. Sohn and Mr. Kirkpatrick had stated, there was just a practical difficulty, and it could only be got over by bringing those in who were now outside the Committee. How this was to be accomplished, the Committee must consider.

The vote was heartily accorded, and Mr. Milne Watson, in acknowledgment, said they had had most inspiring speeches; and he could only wish that more manufacturers of sulphate of ammonia had been present. The meeting was composed largely of the converted.

EXAMINATIONS IN "GAS SUPPLY."

The City and Guilds of London Question Paper.

In the "JOURNAL" last week, we gave (p. 316) the questions set by the Examiner in the "Gas Engineering" examination at the City and Guilds of London Institute held on the previous Saturday. We are now able to give the questions set by Mr. J. H. Brearley, of Longwood, in the "Gas Supply" examination held last Saturday. As on the previous occasion, the candidates were directed to confine themselves to one grade only, and not more than eight numbered questions were to be attempted in the four hours allowed. In the case of questions marked with an asterisk, sketches were to be used. The numbers at the ends of the questions are the maximum marks obtainable.

HONOURS GRADE.

1. (*a*) What general principles determine the efficient lighting of streets and public squares? Describe the means you would adopt for ascertaining the lighting efficiency of a public lamp. [39.]

or, (*b*) How would you ensure accuracy when comparing photometrically the efficiency of incandescent burners? Describe the apparatus you would employ, and give examples of how you would present the results graphically. [39.]

*2. (*a*) Give sketch, in sectional elevation, showing what you consider the best arrangement of fresh-air inlets and foul-air outlets for a four-roomed house, two rooms on each floor, and state the points of construction and conditions upon which efficiency depends. The back and front rooms on the ground floor are assumed to be lighted from centre gas-pendants, and those above from side gas-brackets. Indicate the direction of the air currents. [39.]

or, * (*b*) Show, by sketch or sketches, how gas may be applied as the motive force for exhausting the foul air from rooms, and how such means may be applied to the ventilation of factories where large quantities of gas are used for gassing yarns, heating furnaces, or any similar industrial operation with which you are acquainted. [39.]

3. What means have been employed to increase structurally the durability of incandescent mantles? Give sketch of form of ring support which you consider best for inverted mantles, and reason for your selection. [33.]

4. (*a*) How is the radiation efficiency of a gas-fire affected by the composition and form of the "fuel" and by the manner in which it is fixed above the bunsens? How may the adjustment of the flame affect the percentage which the radiant energy bears to the total heat generated? [36.]

or, (*b*) State what you consider the chief advances in gas-fire construction during the last two years, as shown by the designs published in the Technical Press, and give the causes which have led to the modifications you enumerate. [36.]

5. (*a*) (1) How may carbon monoxide be formed when gas is improperly consumed in lighting and heating appliances? (2) How is the percentage of carbonic acid in air ascertained? (3) Define radiation, conduction, and convection. [36.]

or, (*b*) Explain what is meant by the terms "diffusion" and "humidity." How are diffusion and humidity affected by the artificial lighting of rooms by gas and electricity respectively? [36.]

6. Ten tradespeople, whose shops are approximately equi-distant in a street 400 yards long, apply for a supply of gas at 60 inches pressure to a total of 40 outside shop lamps. Present a scheme for same, including compression of gas, giving capacity of gas-engine and compressors in duplicate, size and type of main, candle power and type of lamp, consumption of gas in engine and lamps per annum, and the maintenance charges for 800 lighting hours in the year. The compressing plant and main must be large enough to supply a further 80 lamps of the type adopted. [42.]

7. What does "coefficient of friction" mean, and what considerations are involved? Dr. Pole placed the factor for "coefficient of friction" at 0·0060 for pipes, irrespective of diameter. In what way has more recent research shown the factor to be inaccurate for certain diameters? Specify these diameters. [36.]

8. Describe an instrument suitable for ascertaining the surface brightness of wall-papers, and its applicability for securing a correct distribution of light for general and special illumination. [36.]

9. With the best type of motor (20 B.H.P.) working continuously for

24 hours, give the quantity required of: (*a*) Town gas (600 B.Th.U. gross) in gas-engine, (*b*) Russian or American oil in oil-engine, (*c*) anthracite in generator of suction gas plant, (*d*) petrol in petrol engine, (*e*) electrical units for motor working from continuous current system. Give the thermal and mechanical efficiency in each case, and define what is meant by these terms. [42.]

10. Draw up a concise specification for a gas-driven electricity plant for supplying current to a 10 B.H.P. motor, two flame arc lamps, each rated at 1000-candle power, and 50 osram lamps of 64-candle power each. State the size of gas-engine required, the quantity of current absorbed per hour with all the installation at work, and the capital cost complete. [42.]

ORDINARY GRADE.

1. (*a*) An escape of gas being detected passing along the inside of disused drain, gas, or water pipes, how would you trace it to its source? [36.]

or, (*b*) How do temperature and atmospheric pressure affect the item "unaccounted-for gas?" A gas undertaking has 9½ miles of mains, 840 consumers, sells 8,760,000 cubic feet of gas, uses on works 190,000 cubic feet, and makes 11,500,000 cubic feet. What is the leakage per cent., per mile of main, and per consumer respectively? How may leakage be systematically reduced? [39.]

*2. (*a*) Dissect fully any 3-light inverted lamp with which you are acquainted. Enumerate and identify the parts with simple sketches, and explain the functions or purpose of each. [42.]

or, (*b*) What constructional points are necessary to a good street-lamp governor? How may deficient governors affect the efficiency of incandescent burners? [36.]

*3. (*a*) Show by sketch and describe a method, other than gas-bags, valves, or syphons, of stopping the supply of gas during mainlaying operations. State, with reasons, your opinion of its utility. [33.]

or, (*b*) How would you proceed to clear mains obstructed by (*a*) corrosion, (*b*) naphthalene, (*c*) water? [33.]

4. (*a*) What are the constructional essentials of a good inverted incandescent burner? How do you ascertain when the gas and air are perfectly adjusted? [39.]

or, * (*b*) Explain, with the aid of simple sketches, the best form of bunsen flame for (*a*) an upright incandescent burner of the "C" type, (*b*) an inverted burner of the "Nico" type, and (*c*) the boiling-burner of a cooker hot plate. [39.]

5. What percentage reduction of useful light do the following types of globes effect when used with an inverted incandescent burner: (*a*) Clear glass, (*b*) white opal, (*c*) clear engraved? How do reflectors affect the proportion of useful light, and what considerations determine their form and construction? [39.]

6. Why is the use of water-slide chandeliers considered inadvisable? Explain the operation of converting one with branches for three lights to modern requirements. [39.]

7. You are sent to remedy complaints made by a consumer that (*a*) his gas-fire, with columnar fuel, does not give sufficient heat, and (*b*) an objectionable smell is given off from the flame of his gas iron-stand when the iron is being heated. Describe how you would proceed to remedy the cause of the complaints. [39.]

8. Describe the operation of fixing a 3-light wet gas-meter. State the size of the connections, the materials and tools used, and the precautions to be observed to ensure a satisfactory supply, including accurate registration. [42.]

9. What points determine the diameter of compo. pipe to be used for interior house fitting? Assuming an adequate service-pipe, with a gas pressure capable of maintaining 2 inches at extremities, give one example each of the use of ¼-inch, ⅜-inch, ½-inch, ¾-inch, and 1-inch pipe. Give in each case the approximate length of pipe required, the burner(s) or appliance(s) for which it is intended, and the consumption of gas when in use. [42.]

10. A gas-engine user complains of porcelain ignition tubes breaking. Inspection shows the tubes to have been fixed correctly, they are of approved quality, and the ignition valve is in perfect order. What, in your opinion, is the cause of the trouble, and how would you proceed to remedy it? [42.]

Barry Water Supply.—Colonel J. A. Hughes presided at a meeting held last Wednesday evening, under the auspices of the Barry Chamber of Trade, when Mr. J. T. Hogg (Chairman of the Barry Gas and Water Committee) delivered an address on the negotiations undertaken by the District Council for obtaining a soft water supply for the town. The Chairman stated that the matter was a most important one for the future of Barry in every direction. Mr. Hogg stated that not only was the present supply unsatisfactory, inasmuch as it was too hard, but, owing to its source, it was also uncertain. It was decided to approve of the scheme.

Electric Light Failures.—A few nights ago, the whole of the electric lights in Torquay failed. At the theatre, the yacht scene in "Brewster's Millions" was just about to be put on, when, without a moment's warning, the house was plunged in absolute darkness. The Managing Director (Mr. W. H. Mortimer) promptly informed the large audience of what had happened, and asked them to keep their seats, as there was no cause for alarm. The audience laughed heartily, especially when the darkness was slightly relieved by the feeble light of a solitary candle deposited in the centre of the stage. In about six minutes the electric light returned, and the play proceeded. On the evening of Saturday, the 29th ult., there was a failure of the electric light in Belfast for about eight minutes, causing great inconvenience at the theatres and other places of entertainment. Hindhead and some of the adjacent districts in Surrey were plunged in darkness last Wednesday night through a fire which occurred early in the morning at the supply station of the Hindhead and District Electric Light Company, which was almost entirely destroyed. All Wednesday there was a run on local stores for candles; and those houses which had gas on as well as electric light were hastily supplied with gas-fittings. Most of the modern residences in the district, however, had only the electric light supplied; and in these the inconvenience was most felt. The streets of the places affected are not lighted by electricity.

IMPERIAL CONTINENTAL GAS ASSOCIATION.

The Half-Yearly Ordinary General Meeting of the Proprietors of the Association was held last Tuesday, at the Cannon Street Hotel—Mr. J. HORSLEY PALMER in the chair.

The SECRETARY (Mr. R. W. Wilson) read the notice convening the meeting, and the report of the Directors was taken as read. In affixing the seal to the Register of Proprietors, the Chairman mentioned that the number of accounts on the register was 6712.

THE SUCCESSES OF THE YEAR.

The CHAIRMAN, in addressing the proprietors, said: It is now my duty to move—"That the report of the Directors upon the affairs of the Association be received and adopted, and entered upon the minutes." This is the first occasion on which we have, prior to the meeting, given to every proprietor a full copy of the Directors' report. Apparently the result is that we have a comparatively small gathering here to-day. It is probably a great advantage to the proprietors to receive the report. The half year under review is a somewhat uninteresting one. We have no great events to chronicle. It has been a year of successes; and also naturally with a great Company like this, working on the Continent in many countries, it has also been a time of a certain amount of anxiety, and perhaps of some difficulty. Let me, just by way of instance, give you a few of the successes. The report tells you that we have, during the past half year, made considerable progress in the sale of gas. The increase is 7 per cent. What does this mean? It means the carbonization of 29,000 tons of coal more than in the corresponding half of 1909, and an output of something like 400 million cubic feet more gas. And this notwithstanding the abnormally mild winter experienced throughout Germany, and I think throughout the whole Continent. Then, again, we have had a considerable increase in the number of consumers—a 9 per cent. increase, which represents an increase of 37,500 new customers. Or if we put it in the shape of meters, 43,000 additional ones were fixed. This seems rather an anomaly. But it is explained by the fact that in many of the towns supplied by the Association we have differential prices for lighting gas and for gas used for cooking, heating, and motive power. The consequence is a great many of the customers have to be supplied with two meters. There is another success to chronicle. We have not on this occasion added any large new area to our supply; but, although we are always looking out, we find it, as you know, increasingly difficult to obtain fresh territory. We have, however, been able to prolong the contract with Etterbeek, an important suburb of Brussels, for twenty years (until 1944). Although the present contract does not expire until 1924, we considered it in the interests of the Association to enter at once into negotiations for the prolongation of the contract. This, gentlemen, is the way in which your Directors have been in the habit of doing business—viz., of looking far ahead. We do not expect this suburb to give us a very large profit in the immediate future; but I feel perfectly certain, considering the growth of Brussels in all directions, that those who come after us will benefit very materially from this prolongation. There have also been smaller areas added to some of the stations which are worked by the Compagnie Continentale du Gaz.

THE LESS ROSY SIDE.

Looking on the other side—the less rosy side—we have had a good deal of anxiety with regard to the sales of coke. I remember that a year ago, I remarked upon the abnormally mild winter of 1909. I said that I, as an old gas director, had no fear of the disposal of the mountains of coke that were then in existence at the works; but I certainly did not calculate on having two consecutive mild winters with which to contend in Germany and throughout Europe. But the result is this—that though we lowered the price considerably, we were not even then able to effect proper sales; and on Dec. 31 last, the stock amounted to no less than 65,000 tons, as compared with 37,000 tons on the same day of 1909. I am glad to say that since the close of the year there has been a cold snap on the Continent, so that we were able not only to sell the coke made during the first three months of the year, but we were able to reduce the stock of 65,000 tons to 47,000 tons. Therefore, gentlemen, we are in a better position at the present moment than we were on Dec. 31 last. There was a sad event which I think it necessary to report, though it took place some time ago—at the beginning of the half year. It was the accident which some of you may have read about in the Continental papers. It occurred at Meaux, which is one of the stations belonging to the Compagnie Continentale; and our Manager (M. Maillot), a very promising young Engineer, and the son of one of the staff in the Paris office, was killed, as well as three of his best men, and three others were also badly injured. The cause of the explosion appears to have been that a valve on the outlet of a gasholder was not properly closed while alterations were being carried out; and an escape of gas ignited at a flame in the governor-house. Due provision has been made by the Compagnie Continentale for the widows and the men who were injured.

EXPENDITURE ON WORKS AND MAINS TO MEET FRESH BUSINESS.

During the half year, we have, of course, been making large extensions—works of construction and enlargement. As our business progresses, it is necessary to lay new mains, to enlarge old mains, and to continue the work of construction at the stations. The money has been spent principally at the Berlin, Brussels, Hanover, Aix-la-Chapelle, and Flushing stations. The total amount spent has been £330,000, and £91,000 of it has gone in new mains or in enlarging existing mains.

POINTS CONCERNING THE PROFITS.

Just for a few minutes, let me turn to the balance-sheet. The actual increase in the profit which can fairly be attributed to the greater volume of the Association's business may be put down at about £9000, which is equivalent to an increase of 4½ per cent. This increase in profit, however, was augmented by an addition to the dividend (somewhat delayed) which we received from the Frankfort Gas Company, and which had to be included in the accounts this half year—viz., £36,000—as well as by the fact that the proprietors have on this occa-

sion been charged with the income-tax (about £13,000) on their dividends, while in the corresponding half year this was charged against the profits. The total increase in the profit, as shown by the balance-sheet, amounts to £58,177. A proprietor wrote to me the other day, asking whether the Compagnie Continentale had paid any dividend, and whether it was embodied in the report now before you. We received no dividend from the Compagnie Continentale, though one of 2½ per cent. was declared; but it will come into the accounts for the current half year. The Company did not declare any larger dividend, because they had great difficulties to encounter on account of the inundations which took place in France more than a year ago (as fully described to you in my speech a year since) and which necessitated a very large outlay indeed upon the repair of the works and the mains. I have no fear whatsoever as to the future prospects of the Compagnie Continentale.

DIVISION OF THE AVAILABLE PROFITS.

Then, gentlemen, as the Secretary has not on this occasion read to you the scheme which the Directors have drawn up for the division of the profits, I must do so. It is as follows:—

Balance brought forward from last half year . .	£16,547	14	0
Profit resulting from the workings at the stations, and dividends on investments, less interest on debenture stock, and the charges on account of depreciation and income-tax	272,030	9	3
	£288,578	3	3
Dividend of 4½ per cent. for the half year . . .	£222,300	0	0
Credit to pension reserve	40,000	0	0
Balance carried forward to next half year . . .	26,278	3	3
	£288,578	3	3

THE PENSION FUND.

You will notice the Directors propose to again put to the pension reserve £40,000. This brings the fund up to £375,000. A proprietor wrote to me the other day, inquiring whether the Directors were going to limit, or fix any limit for, the pension reserve. I answered him that, in my private opinion (quite apart from anything my brother Directors may feel on the matter), the Company would not be safe—looking at the pensions already paid, and the liabilities we are going to incur when Vienna is given up—without a sum of at least a million sterling. I do not know whether the proprietor is present, but I think he must be a new one, or else he could not possibly have carefully read the remarks I have made on many previous occasions with regard to the pension fund. But just to refresh your memories a little, I may say that the total amount of the pensions paid for the year to Dec. 31 last was £37,166. Of this, £20,040 is the amount of pensions to retired salaried officers, or to the widows of salaried officers, and £17,126 is the amount of pensions to workmen and to workmen's widows. As I have said, this does not represent the liabilities which have to be incurred when we part with Vienna at the end of this year. I have told you at past half-yearly meetings a great deal with regard to the Vienna station; and there is no question that considerable provision will have to be made for the staff of workmen there who have grown old in your service. And quite apart from this, it does not represent the total amount the Association have to meet for benevolent purposes; for we are compelled by law in the various countries where we are doing business to contribute very largely indeed towards workmen's sick and accident funds, at a cost of nearly £15,000 a year.

INVESTMENTS AND MARKET VALUE.

There is very little to say on the liability side of the balance-sheet, which is very clearly set out. With regard to the assets side, I only wish to remark on the investments in English, Colonial, and Indian securities. This item shows a decrease of £35,455, which is entirely owing to the provision made for gradually reducing the reserve fund investment to its market value. It is really a transfer from one account to another. The reserve now represents £448,000 of 2½ per cent. Consols, which stand at an average of 89·28.

MR. SALOMONS' JUBILEE.

I have been in the habit of concluding my remarks by mentioning any matters of domestic interest which may have taken place since the close of the half year. The only point I wish to speak about on this occasion is the jubilee of Mr. Salomons. This is the seventh occasion on which we have had to celebrate the jubilee of an employee of the Association. Mr. Salomons entered our service, at the age of 18, in 1861; and therefore completed his fifty years' service in February this year. I had the great pleasure of going to Brussels, accompanied by Sir Charles Jessel and Mr. Wilkinson, to attend the festivities which generally take place on the Continent on the occasion of a jubilee. I can only say it was one of the pleasantest, and it was also one of the hardest, tasks that a Director of the Imperial Continental Association has to perform. The Board presented Mr. Salomons with a gold watch, with a suitable inscription, as a souvenir of the event. He was also the recipient of testimonials of regard from his colleagues and the staff of workmen, all of whom joined in wishing him a very happy time at his jubilee. This is all I have to say to-day on the report and balance-sheet; and I thank you for the attention with which you have listened to the remarks I have made.

Mr. J. H. Birchenough, C.M.G., seconded the motion.

Sir John Runtz remarked that the Chairman had covered the whole ground of the operations of the last six months. But he did think the Chairman, with his usual modesty, had not put the figures quite so favourably as he might have done. He (Sir John) had been looking through the accounts, and comparing the figures with those of twelve months ago; and the comparison showed that the increase in the prosperity of the Association had been remarkable. The Chairman had referred to the pension fund which was growing very rapidly. He (Sir John) had thought that this fund was approaching its maximum; but when they heard from the Chairman of the large liability that was likely to be incurred in connection with the discharge of so many employees at Vienna, he thought the Board had adopted a wise and a prudent course in looking forward to a still greater growth for the fund. Was he right in saying the increase in the past year had been £80,000, by putting by £40,000 each half year? [The Chairman: Yes.] Then he found that the profit at December, 1909, was £213,000; and now it was £272,000, or an increase of £60,000. All these figures were extremely satisfactory; and if the Company continued to increase as they were now doing, they would have every reason to continue to be gratified. They had heard from the Chairman of the large increase—9 per cent.—in the number of consumers, and of the 7·11 per cent. increase in the output of gas. These were indications that the Association was growing at a great rate. He was glad to find that some portion of their investment was now standing in the books at approximately the market value. He supposed that the income-tax deduction inaugurated last half year had come to stay. They would all have liked—and he spoke with an experience of 40 years—to have continued to receive their dividends net, as they had done since the Company was formed. On the other hand, it brought forcibly home to the minds of the proprietors that they still had a confiscatory and revolutionary Government in power; while if they had the dividends in full, they were not so effectively reminded of the fact. [Laughter.] He therefore thought the deduction of the income-tax had one great advantage; and he considered it a good thing that John Bull should be awakened to the seriousness of the position.

The Chairman said he should like to remind Sir John Runtz that they were losing Vienna at the end of this year.

The motion was unanimously carried.

On the proposition of the Chairman, seconded by Mr. R. Tindall, a dividend of 4½ per cent., less income-tax, for the half year was declared payable on the £4,940,000 of capital stock.

Proposed by the Chairman, and seconded by the Hon. Sir E. Chandos Leigh, K.C.B., K.C., the retiring Directors (Mr. Arthur Lucas, Mr. H. G. Newton, and Colonel H. Le Roy-Lewis), were re-appointed.

Moved by Mr. Bernard F. Harris, and seconded by Mr. A. Bailey, the retiring Auditor (Mr. J. Gurney Fox) was re-appointed.

Sir John Runtz moved a vote of thanks to the Chairman and Directors for the excellent report which they had been able to present to the proprietors as the result of their management of the affairs of the Association. They had, he said, had ample evidence that the Chairman's usual vigour was maintained; and they all hoped he would be spared for many years to give them such clear statements as he had done each half year for many years past.

Mr. Dendy Marshall seconded the motion, which was unanimously carried.

The Chairman said the Board heartily thanked the proprietors, and also Sir John Runtz, for what he had so kindly said as to the way the Directors were devoted to the services of the Association. They all proposed to continue this devotion as long as they were present on the Board. He had now to move that a cordial vote of thanks be given to the staff. Many of the proprietors came in contact with their genial and capable Secretary; but not many of them came in contact with the staff on the Continent. It was the Directors' privilege to know every one of them individually; and he could assure the proprietors that their interests were admirably served by everybody who was in their employ, whether on the Continent or in their home office.

Mr. Corbet Woodall seconded the motion; and it was cordially carried.

The Secretary, in the name of the whole staff at home and abroad, heartily thanked the proprietors for the recognition of their services.

This concluded the proceedings.

SOUTHAMPTON GASLIGHT AND COKE COMPANY.

The Half-Yearly Meeting of the Company was held last Wednesday, at Southampton—Captain A. J. Corse Scott in the chair.

The Chairman, in moving the adoption of the report, said it was one of the best the Board had had the pleasure of submitting to the shareholders; and he believed that the undertaking was in a sounder position now than it had ever been during the 27 years he had been a Director. The stockholders had received a copy of the report, together with the accounts and balance-sheet for the past half year; and they would see that they had again earned sufficient to pay the maximum dividend of 5 per cent., after meeting all charges, and also to carry forward to the present half year an undivided balance of £750. He was glad to say that the sale of gas was still increasing. During the past winter, there had been a good demand for gas-fires; the consumers evidently appreciated their usefulness, especially for heating bedrooms, &c., without any trouble or dirt. From the beginning of February last, the price of gas to prepayment consumers in the added areas had been reduced; and this concession had been greatly appreciated. But it meant a loss in revenue of something like £1000 a year. For some time past, it had been in the minds of the Directors to provide an up-to-date show-room, but the difficulty had been to find a shop in a prominent place suitable for the requirements of the Company. However, they had now purchased premises adjacent to the central offices. After the necessary alterations had been completed, these premises would be fitted up to display all the latest gas appliances for lighting, heating, and cooking; and there would also be a large lecture-hall, in which cookery demonstrations would be given from time to time, and information on the best methods of using gas in every way would be freely furnished to all consumers. To purchase this freehold, and also for the extension of the Company's business, a further issue of stock was made in March last; and the Directors were pleased to report that the amount required was readily taken up. The building of the new workshops was now completed, the machinery was being installed, and very shortly the buildings would be brought into use. The works of the Company were well maintained.

The report was adopted, the maximum dividend declared, and the Chairman and Directors, the Secretary (Mr. J. R. H. Jacobs), the Resident Engineer and Manager (Mr. S. W. Durkin), and the staff generally, were thanked for their services.

HUDDERSFIELD GAS AND WATER SUPPLY.

The estimates of the expenditure of the Huddersfield Corporation in the financial year ending March 31, 1912, recently came before the Town Council for adoption. In the course of his speech in submitting them, Mr. Ernest Woodhead stated that the revenue account of the gas-works fund showed a surplus on the year of £8687, compared with £5884 before. There had been an increase in the gas-rental of £5556. The Gas Committee had decided to transfer £5842 in relief of the borough rates, equal to 3d. in the pound, and the balance of £2845 to the depreciation and contingencies account. The latter account now showed a credit balance of £35,609. This result spoke of great care and ability in the management of the undertaking, and must give much satisfaction to the ratepayers, who had the burden of the rate kept down while paying very reasonable prices for gas, and at the same time had the gratification of knowing that the contingencies fund account had been increased by nearly £3000. With regard to the water-works revenue account, it showed a deficiency of £11,683, compared with £17,155 this time last year; and the Committee asked for an amount equal to a rate of 6d. in the pound. There had been an increase in the revenue of £9034, consequent on the revision of the charges for water, which came into operation on April 1, 1910. Of this increased income, £2300 came from outside the borough, and the balance of £6734 from inside. From the latter figure should be deducted the amount of the reduced borough rate of 3d. in the pound—viz., £5842; leaving a net contribution from ratepayers of £892, against £2300 from those outside the borough as the result of the revision of the water charges. The depreciation and contingencies account stood at £20,359.

Testing Wandsworth Gas.—In compliance with representations made by the Wandsworth Borough Council, the Wandsworth and Putney Gas Company have agreed to the use of the No. 2 "Metropolitan" burner for testing the illuminating power of their gas; and they will also provide the apparatus for testing its calorific power.

High-Pressure Lighting in Lambeth.—At the meeting of the Lambeth Borough Council last Thursday, a letter was received from Mr. H. Talbot, the Lighting Superintendent of the South Metropolitan Gas Company, on the subject of the lighting round the Town Hall. He said the Company suggested the fitting up of a 3000-candle power lamp on the island in front of the building, one of similar power on each of the columns where there are now three lamps, a 1000-candle power lamp on each of the columns where there are now two lamps, and 500-candle power lamps on the others. The ordinary charges per annum for these lamps are: For 3000-candle power lamps, £20; for 1000-candle lamps, £12 10s.; and for 500-candle lamps, £7 10s.—making a total of £130. Mr. Talbot added that the cost of supplying and fixing the new columns and lamps would be borne by the Company, who did not suggest altering the present charge (£89 12s.), on condition that the Council would allow them sufficient space to fit up a compressor-house about 12 feet square on the ground at the back of the Town Hall. The Council accepted the proposal of the Company, subject to protective conditions.

PROFITS IN AID OF RATES IN MANCHESTER.

Question to be Considered by a Special Committee.

At the Meeting of the Manchester City Council last Wednesday, a resolution was submitted for the appointment of a Special Committee to consider the basis on which the Trading Committees of the Corporation should make contributions in aid of the rates.

The Lord Mayor (Councillor Charles Behrens), in moving the resolution, said it had been a matter of great anxiety to him, since he had been placed in the position he occupied, to find that a certain amount of friction had existed between two of the most important trading Committees of the Corporation—the Gas and Electricity Committees. This friction had been caused by a natural wish of each Committee to carry on the work of their department with the greatest possible efficiency and financial success. Conferences had been held, and a report was in the hands of the Council; but he thought the time had now arrived when not only these two Committees but the other trading committees should consider the question of their contribution in aid of the city rates. Therefore he should like his resolution to include the formation of a Committee composed of the Chairmen and Deputy-Chairmen of the Gas, Electricity, Tramways, Markets, Water-Works, and Finance Committees, together with the Lord Mayor—thirteen members in all. The Committee would consider the basis on which the contributions in aid of rates should be made, and submit a report to the Council at the earliest possible opportunity. He thought the Council would agree with him that such a course might lead to very valuable results.

Alderman Holt, in seconding the resolution, said they had reached a crisis in the history of the city, in so far as the rating powers were concerned; and they would have to take steps to ensure that the Corporation was run on business lines.

Mr. Fox, in supporting the resolution, suggested that the Special Committee should include three independent members of the Council, in addition to those named by the Lord Mayor.

The Lord Mayor said he had no objection.

The names of Aldermen Carter and Smethurst and Mr. T. Fox were then added to the Committee; and the resolution, as amended, was carried.

The minutes of the Electricity Committee contained a resolution that for the present year, and onward, the department's contribution in relief of rates should be 1 per cent. on the mortgage debt outstanding at the close of the preceding year. On the motion of Alderman Copeland, the Chairman of the Finance Committee, this resolution was referred back by the Council, in view of the fact that the Special Committee appointed earlier in the day would consider the whole question.

The estimates of the different Committees will be dealt with at a meeting of the Council to-morrow. The estimated average rate required for municipal and sanitary purposes for the current year is 6s. 9·8d. in the pound, as against the revised rate of 6s. 8·7d. levied in 1910—an increase of 1·1d. in the pound. But for the additional amounts to be received from the Ship Canal Company and the Trading Committees of the Corporation, the average city rate would

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 358.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Apl. 12	5	Alliance & Dublin Ord.	83—86	..	5 16 3
374,000	Stk.	Jan. 13	4	Do. 4 p.c. Deb.	95—97	..	4 2 6
200,000	5	Oct. 28	7	Bombay, Ltd.	6½—7	..	5 0 0
40,000	5	,,	7	Do. New, £4 paid	5½—6	..	4 13 4
50,000	10	Feb. 24	15	Bourne- mouth Gas & Water } 10 p.c.	28—29	..	5 3 5
311,810	10	,,	7	,, B 7 p.c.	16—16½	..	4 4 10
75,000	10	,,	6	,, Pref. 6 p.c.	14½—15	..	4 0 0
380,000	Stk.	,,	12½	Brentford Consolidated	255—260	+2	4 16 2
330,000	,,	,,	9½	Do. New	199—204	+2½	4 13 2
50,000	,,	,,	5	Do. 5 p.c. Pref.	122—124	..	4 0 8
206,250	,,	Dec. 15	4	Do. 4 p.c. Deb.	99—101	..	3 19 3
220,000	Stk.	Mar. 10	11	Brighton & Hove Orig.	215—218	..	5 0 11
246,320	,,	,,	8	Do. A Ord. Stk.	157—160	+2	5 0 0
460,000	20	Apl. 12	10½	British	43½—44½	..	4 15 4
120,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb. Stk.	96—98	..	4 1 8
109,000	,,	Feb. 10	6	Bromley, A 5 p.c.	116—118	..	5 1 8
165,700	,,	,,	4½	Do. B 3½ p.c.	87—89	..	5 1 2
82,278	,,	,,	5½	Do. C 5 p.c.	106—108	..	5 1 10
55,000	,,	Dec. 30	3½	Do. 3½ p.c. Deb.	84—86	..	4 1 5
250,000	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	96—98	..	4 1 8
100,000	10	,,	—	Cape Town & Dis., Ltd.	3½—4½	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	6—6½	..	—
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	—	..	—
100,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	88—90	..	5 0 0
157,150	Stk.	Feb. 24	5	Chester 5 p.c. Ord.	109—111	..	4 10 1
1,513,280	Stk.	,,	5/9/4	Commercial 4 p.c. Stk.	113—116	..	4 14 3
560,000	,,	,,	5½	Do. 3½ p.c. do.	108—110	..	4 16 11
475,000	,,	Dec. 15	3	Do. 3 p.c. Deb. Stk.	77—79	..	3 15 11
800,000	Stk.	,,	4	Continental Union, Ltd.	95—97	..	4 2 6
200,000	,,	,,	7	Do. 7 p.c. Pref.	136—138	..	5 1 5
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,000	,,	—	4	Do. Deb. Stk.	104—105	..	3 16 2
148,995	,,	Apl. 12	5	East Hull 5 p.c. Ord.	—	..	—
840,150	10	Jan. 27	10	European, Ltd.	19—20	..	5 0 0
16,179,445	Stk.	Feb. 24	4¾	Gas- light and Coke } 4 p.c. Ord.	105½—106½	..	4 7 7
2,600,000	,,	,,	3½	,, 3½ p.c. max.	85—87	..	4 0 6
4,062,235	,,	,,	4	,, 4 p.c. Con. Pref.	101—103	..	3 17 8
4,531,705	,,	Dec. 15	3	,, 3 p.c. Con. Deb.	79—81	..	3 14 1
258,740	Stk.	Mar. 10	5	Hastings & St. L. 3½ p.c.	92—94	..	5 6 5
82,500	,,	,,	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Apl. 27	11	Hongkong & China, Ltd.	17—17½*	..	6 5 8
131,000	Stk.	Mar. 10	7½	Ilford A and C	145—148	+2	4 19 8
65,780	,,	,,	5½	Do. B	115—117	+2	5 0 5
65,500	,,	Dec. 30	4	Do. 4 p.c. Deb.	96—98	..	4 1 8
£			p.c.				£ s. d.
4,940,000	Stk.	Nov. 11	9	Imperial Continental	191—193	..	4 13 3
1,235,000	Stk.	Feb. 10	3½	Do. 3½ p.c. Deb. Red.	92—94	..	3 14 6
200,242	Stk.	Mar. 10	6	Lea Bridge Ord. 5 p.c.	119—121	..	4 19 2
561,000	Stk.	Feb. 24	10	Liverpool United A.	214—216	..	4 12 7
718,100	,,	,,	7	Do. B.	163—165	..	4 4 10
306,083	,,	Dec. 30	4	Do. Deb. Stk.	102½—104½	..	3 16 7
75,000	5	Dec. 15	6	Malta & Mediterranean	4½—5	..	6 0 0
560,000	100	Apl. 1	5	Met. of 5 p.c. Deb.	100—102	..	4 18 0
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	100—102	..	4 8 3
541,920	20	Nov. 11	3½	Monte Video, Ltd.	13—13½	..	5 3 8
1,775,892	Stk.	Feb. 24	4¾	Newc'tle&G'tesh'd Con.	101—103	..	4 5 0
529,705	Stk.	Dec. 30	3½	Do. 3½ p.c. Deb.	89—90	..	3 17 9
55,940	10	Mar. 10	7	North Middlesex 7 p.c.	14½—15½	..	4 10 4
300,000	Stk.	Apl. 27	8	Oriental, Ltd.	136—138*	..	5 15 11
60,000	5	Apl. 12	8	Ottoman, Ltd.	6¾—7¼	..	5 10 4
31,800	53	Feb. 24	13	Portsea Island A	135—140	..	4 18 4
60,000	50	,,	13	Do. B	—	..	—
100,000	50	,,	12	Do. C	120—125	..	4 16 0
114,800	50	,,	10	Do. D and E.	—	..	—
398,490	5	Oct. 28	8†	Primitiva Ord.	7⅞—8½	+⅛	4 18 6
796,980	5	Dec. 30	5	Do. 5 p.c. Pref.	5¼—5½	..	4 10 11
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	97—99	..	4 0 10
312,650	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	96—98	..	4 1 8
250,000	10	Mar. 24	9	San Paulo, Ltd.	15⅝—16½	..	5 10 9
115,000	10	,,	6	Do. 6 p.c. Pref.	11½—12	..	5 0 0
125,000	50	Jan. 3	5	Do. 5 p.c. Deb.	50—51	..	4 18 0
135,000	Stk.	Mar. 24	10	Sheffield A	235—237	..	4 4 5
209,984	,,	,,	10	Do. B	235—237	..	4 4 5
523,500	,,	,,	10	Do. C	234—236	..	4 4 9
70,000	10	Oct. 14	6	South African	9—10	..	6 0 0
6,429,895	Stk.	Feb. 10	5/9/4	South Met., 4 p.c. Ord.	119—121	..	4 10 3
1,895,445	,,	Jan. 13	3	Do. 3 p.c. Deb.	79½—81½	+½	3 13 7
209,820	Stk.	Mar. 10	8	South Shields Con. Stk.	154—156	..	5 2 7
605,000	Stk.	Feb. 24	5⅜	S'th Suburb'n Ord. 5 p.c.	119—121	..	4 13 6
60,000	,,	,,	5	Do. 5 p.c. Pref.	118—120	..	4 3 4
117,058	,,	Jan. 13	5	Do. 5 p.c. Deb. Stk.	122—124	..	4 0 8
502,310	Stk.	Nov. 11	5	Southampton Ord.	111—113	..	4 8 6
120,000	Stk.	Feb. 10	7	Tottenham A 5 p.c. and B 3½ p.c.	141—143	..	4 17 11
483,940	,,	,,	5½		115—117	..	4 14 0
149,470	,,	Dec. 15	4	Edmonton 4 p.c. Deb.	98—100	..	4 0 0
182,380	10	Dec. 30	8	Tuscan, Ltd.	9—9½	..	8 8 6
149,900	10	Jan. 3	5	Do. 5 p.c. Deb. Red.	98—100	..	5 0 0
236,476	Stk.	Feb. 24	5	Tynemouth, 5 p.c. max.	115—117	+1	4 5 6
255,636	Stk.	Feb. 24	6¾	Wands- worth B 3½ p.c.	141—143	..	4 14 5
85,766	,,	Dec. 30	3	,, 3 p.c. Deb. Stk.	73—75	..	4 5 6

† Next dividend will be at this rate. Prices marked * are "Ex. div."

have been advanced by 2·1d. in the pound. There is a very strong feeling against any increase in the rates for the current year. It is evident, however, that, if there is not to be an advance, it will be necessary either to further cut down the estimates of the chief spending Committees, or to demand from the profit-earning departments a larger grant than that proposed. It is not improbable that both expedients will be adopted—that there will be a further pruning of the estimates, and that the balance of the £20,000 needed to avoid an increased rate will be asked from the Tramways and Gas Departments.

SALFORD GAS CHARGES.

Proposed Reduction in Price and an Inquiry Rejected.

A resolution aiming at a reduction in the price of gas brought before the Salford Town Council at last Wednesday's meeting by a Labour member, together with a proposal to the effect that a Special Committee be appointed to inquire into the working of the Gas Department, led to a somewhat heated discussion.

Mr. PURCELL moved that the Gas Committee be instructed to so arrange the charges for gas in the borough that the price from the 1st of July next should be 2s. 3d. per 1000 cubic feet to ordinary consumers, and that prepayment meter users should be supplied with 33 instead of 30 cubic feet of gas for 1d. He said it was not a question whether or not they could afford the proposed reduction; the people were entitled to it. The consumers of gas on one side of a street ought not to be charged a higher price than those on the other, simply because one side was in Salford and the other in Manchester. The adoption of his resolution would place consumers in both towns on the same scale.

The resolution having been seconded, considerable discussion ensued. It was elicited that Mr. Purcell, who is on the Gas Committee, had not brought the matter before the members, which led Mr. Mather to say it was an insult to the Committee to submit it to the Council first, and therefore he should oppose it. Another Councillor (Mr. Bescoby) deplored the fact that an attempt was being made to force the hands of the Gas Committee through the Council; this being, in his opinion, a most reprehensible action.

Finally, an amendment to the effect that the whole question be referred to the Gas Committee, was carried by 28 votes to 7.

Mr. WHEATCROFT proposed a further amendment that Mr. Purcell's resolution be referred to a Special Committee, with instructions to investigate it, and, further, to inquire into the general conduct, management, and policy of the gas undertaking; also that, in view of the state of feeling in the town with regard to the matter, such inquiry should be carried out by an entirely independent and impartial body. He said it had been freely whispered among members of the Council that all was not well with the gas undertaking; and some of the bolder spirits had gone beyond this.

The amendment having been seconded, a question arose as to its being in order; but the Mayor (Alderman Phillips), who is Chairman of the Gas Committee, admitted it. Opinions having been expressed that there was not sufficient reason for an investigation being made, the amendment was defeated by 19 votes to 9.

DUKINFIELD GAS DEPARTMENT.

The Past Year's Working.

The Manager of the Dukinfield Corporation Gas Department (Mr. William Lindley) reports that the carbonizing plant worked satisfactorily during the financial year ended the 31st of March. The total quantity of gas accounted for was 85,533,700 cubic feet, apportioned as follows: Cottages, by ordinary meters, 40,426,000 cubic feet; do., slot-meter consumers, 11,754,700 cubic feet; mills, 25,958,600 cubic feet; public lamps, 6,174,300 cubic feet; offices, works, &c., 1,219,700 cubic feet. The total revenue for the year was £13,801 (£10,535 for gas), and the expenditure £9615 (£5117 being for coal); leaving a gross profit of £4186. Adding £31 received as cottage rents, a total of £4217 was produced. Of this sum, £3110 was required for annuities, interest, and sinking fund; leaving a net profit of £1107, compared with a profit of £477 for the year 1909-10, and of £868 for 1908-9.

According to a table (verified by Mr. William Moss, of Ashton-under-Lyne) showing the cost of gas per 1000 cubic feet sold for the past and the preceding financial years, the total cost of production in the former was 2s. 2·45d. and in the latter 2s. 4·41d.; the average prices being 2s. 5·56d. and 2s. 5·86d. There was consequently a gain of 3·11d. in 1910-11, compared with 1·45d. in the preceding year and 2·59d. in 1908-9.

Mr. Lindley is to be again congratulated on the excellent results of his year's work. The quantity of coal and cannel carbonized in the twelve months was 7921 tons; and the total make of gas was 92,554,000 cubic feet. As the quantity sold was 85,533,700 cubic feet, the unaccounted-for gas was 7,020,300 cubic feet, or 7·58 per cent. The make and sale per ton of coal were 11,684 and 10,798 cubic feet respectively, compared with 11,567 and 10,669 cubic feet in 1909-10.

In moving the adoption of the Gas Committee's minutes at the monthly meeting of the Town Council on Monday last week, the Chairman (Mr. J. Cooke) said the Committee were very pleased with the result of the past year's working. There was an increased sale of 7 million cubic feet of gas, which he regarded as very satisfactory. They had sold 85½ millions, which was the highest figure they had had since they were separated from Denton. The leakage had been kept low—7½ per cent. The carbonizing plant had yielded 11,684 cubic feet per ton of coal; and they had sold about 10,800 cubic feet, which he thought would compare favourably with any other plant. The Committee unanimously recommended a reduction of 2d. per 1000 cubic feet in the price of gas; so that the maximum price would be 2s. 4d.,

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and the minimum price 1s. 11d.—a result which no member of the Council ten years ago would have thought they would ever attain. Even with the reduction, he hoped to be able to report satisfactorily at the end of the current year. Alderman Grime, in seconding the motion, said he was under the impression that large consumers were diminishing, as they were going in so extensively for electricity. They were all pleased that the working of the gas undertaking had exceeded their expectations. He thought when electricity became so cheap they would have the gas-works as a white elephant. Mr. Cooke said, with regard to the large consumers, a great deal of the increased consumption—some 4½ millions—was due to mills, owing to their working full time, whereas in the previous year they were running short time. The motion was carried.

GAS AND ELECTRICITY AT LOUGHBOROUGH.

When presenting the balance-sheets of the Gas and Electricity Departments to the Loughborough Town Council, Alderman Bumpus, referring first to gas, said he thought it was a matter of congratulation that the gross revenue account showed a very substantial increase for the year ending March 31. The increase was £626 over the revenue figures for the previous year. This, in a time of no very great prosperity in the town, was satisfactory. It might be said that it had been achieved by some favourable circumstances. For example, they had no charge for the new gasholder, payment of which was extinguished in the previous year. But if they went behind the figures in this way, they also should remember the undertaking had to face an increased price of coal, which practically wiped off such saving as was made on the gasholder. There was only a very small increase in consumption—less than 3 per cent.—and not material enough to secure much increased profit. They had been fortunate in the market for residuals; and, in addition, strict attention had been paid during the year to producing more efficiently and more economically, and the management was certainly to be credited with some share of the result. They had a gross profit of £7660. The standing charges were £6907; and this left £753 to be carried forward on the year's working. They commenced with a deficit of £275; and with the £753 they had in hand, they now had a credit balance of £478 to the account of profit and loss, which he thought would be agreed was very satisfactory. They were much dependent upon the consumption of gas. If they were not so favourably circumstanced for residuals, and had no increase of consumption, they might not do so well in the coming year as in the past. Regarding the Electricity Department, broadly, the results of the year's working were that the gross profit on the revenue account was £1873—an increase over the previous year of £1020, which was a very substantial advance in the financial condition of the undertaking. Again, as in the gas balance-sheet, they could not quite credit the whole of the gain to the improved working of the undertaking, inasmuch as there was a charge of £300 a year for paying off the cost of a battery, and this payment expired last year; so that as compared with the previous year the advance was £720. There had been a large increase in the output; but, as in previous years, the increase was more on power, which was lower priced, than on lighting. The increased current sold for power was about 50 per cent.; and for lighting about 12 to 15 per cent. Along with all this was a decrease in the cost per unit. In 1908, the cost was nearly 2¼d.; in 1909, 2d.; in 1910, less than 1½d., and in the past year, $\frac{9}{10}$d. The net result was that they had a gross profit of £1873. Their standing charges were £2203; and therefore they had made a loss on the year of £330. Against this, there was a grant of £1500 from the rates towards the loss on the working of the year, and also towards working off the accumulated deficit.

ROTHERHAM CORPORATION GAS DEPARTMENT.

Among the annual statements on the financial position of Rotherham, and the working of the various undertakings of the Corporation, made at the meeting of the Town Council last Wednesday, was one by Alderman Gummer, the Chairman of the Gas Committee. In submitting the report of the Gas Department, he gave particulars of the undertaking. He said he was sorry in one respect it was not quite so rosy as he should like to have seen it. The increased make of gas had not been quite up to their expectations; this being chiefly brought about by the number of works that had been on short time, and by some of them whose doors unfortunately were nearly closed. The increased make of gas was 9¼ million cubic feet; the make in 1910-11 being 305½ millions, compared with 296¼ millions in the year 1909-10. This had chiefly been brought about by the extensions to Thrybergh. If it were not for the extensions made outside the borough, in all probability the increased make would have greatly depreciated, and in time would have rapidly gone down. Unfortunately for the gas undertaking, the more fashionable electric light seemed to have taken hold of a number of people. He expressed a hope that an increased consumption of gas for power and for cooking purposes would be able to keep the rate of consumption at its normal increase. Out of the gross profits of the department, there had been contributed to the rates £33,206—an average of £5541 in the last six years.

The Inverurie Gas Company, Limited, was registered in Edinburgh last week. The capital is £2250, in shares of £1 5s. There are negotiations in progress at present for the transfer of the Company's undertaking to the Corporation.

Owing to the fusing of an electric light wire in a sitting-room at the Imperial Hotel, Barnstaple, last Tuesday night, the adjoining gas-pipe melted, and several explosions occurred through the gas escaping. The ceilings in the room and corridor were damaged.

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THE SUICIDE OF A GAS COMPANY'S OFFICIAL.

The Coroner's Inquest.

In the "JOURNAL" last week (p. 326), we recorded the circumstances attending the death by suicide, on the 28th ult., of Mr. Stephen J. Symonds, the Engineer, Manager, and Secretary of the Farnham Gas and Electricity Company. The matter was inquired into next day by Mr. RUTLEY MOWLL and a Jury, sitting at the Ashford Police Court.

Mr. *J. W. Symonds*, of Dover, father of deceased, said his son lived at Farnham, Surrey, and was Manager and Secretary of the Farnham Gas Company. He was 39 years of age and was married. On the night of Tuesday, April 25, witness saw him off by the 8.50 train from Dover to Charing Cross; and on Thursday morning he received a telegram from him, saying: "Feeling better; shall arrive to-night." He had been suffering from a nervous breakdown, and had spent the previous week-end at Dover. The only reason witness could suggest for the suicide was that he had had a great deal of illness and trouble. He had been living apart from his wife for some time. He had no business troubles; and the books of his Company were in perfect order. When he went to town on Tuesday, he was accompanied by a nurse, who, being unwell, was unable to attend the inquiry. He telegraphed for her to come to him on Tuesday and take him home.

Mr. *R. J. Dawes*, of Southampton, one of the occupants of the carriage in which the deceased and the nurse travelled, described what took place. In answer to the Foreman of the Jury, he said there was nothing unusual about the conversation of Symonds and the lady with him; but he noticed that during the journey the hands of deceased were twitching.

Richard Bond, the guard of the train, described the condition in which he found the body.

Dr. *Robert H. Campbell*, of Folkestone, who was a passenger in the train, said that he had examined the body. The cause of death was hæmorrhage resulting from self-inflicted wounds, made by broken glass, in the wrist and neck.

Mr. *J. W. Symonds*, recalled, said his son had lately been working very hard, and his breakdown was caused by overwork and domestic trouble.

The CORONER said although the Jury might wish to get a clear idea as to the motive, there was no doubt as to the actual deed. He pointed out that deceased was evidently an able man, and had been very ill. It was noticed he was in a nervous state, and the Jury might, if they wished, return a verdict of "Suicide during temporary insanity."

This verdict was returned; and the Jury expressed their sympathy with the father of the deceased.

Messrs. James Milne and Son, Limited, have appointed Mr. A. O'Grady (formerly with Messrs. William Sugg and Co.) as their representative for the South Coast.

GAS-METER TESTING IN MANCHESTER.

At the last Quarterly Meeting of the Manchester City Justices, the annual report of the Inspector of Gas-Meters (Mr. G. Dyson), which was presented to them, showed that during the year ended the 31st of March the number of meters tested was 41,969. The fees received amounted to £1641—a decrease of £29; and the expenditure amounted to £1993. The total number of meters rejected was 1010, or 2·4 per cent.; and of 32,941 dry meters tested, 817 were rejected. The total of rejections showed a decrease of 776 as compared with the previous year. For the last nine years the "index test" has been applied to all Corporation meters passing through the department. During the year just ended, the indices of 13,439 dry meters and 4795 wet meters were tested, and only 21 were found incorrect, compared with 56 in the previous year. The Gas Committee of the Corporation submitted for testing 662 meters, which had been in use upwards of ten years; and 441, or 66·6 per cent., proved to be incorrect.

The Chairman of the Gas-Meter Testing Committee (Mr. N. Bradley) moved the adoption of the report, and, in reply to questions, stated that with regard to penny-in-the-slot meters the apparatus was independent of the meter. If the apparatus got out of order, it would not affect the meter or the quantity of gas consumed. With respect to the Corporation meters which had proved to be incorrect, he believed they registered in favour of the consumer rather than of the Gas Committee. He thought wet meters were not giving place to dry ones. There was no preference. The Lord Mayor (who occupied the chair) suggested that the electric light meters should be under the control of the Justices. Mr. Bradley said the Committee had been advocating this for a number of years. A Commissioner from London had been in Manchester making inquiries on the subject; but no report had been received from him.

THAMES RESERVOIRS SCHEME ABANDONED.

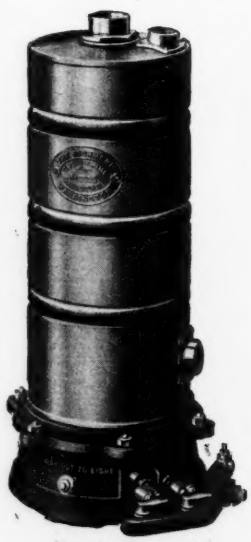
At the Meeting of the Metropolitan Water Board last Friday, the Chairman of the Law and Parliamentary Committee (Mr. J. B. P. Karslake) referred to the Board's reservoir scheme, which, as recorded in the "JOURNAL," has been under consideration by a Joint Select Committee of Parliament. The scheme originally provided for the construction in the Thames Valley of eight reservoirs, which were calculated to supply London with water till 1941. As the Committee have considerably curtailed the scheme, Mr. Karslake asked the Board if they were justified in proceeding with it. The reservoir capacity provided by the Board was sufficient for the needs of London until 1919 or longer. As the Board had still time to think out a new scheme, their policy should be to withdraw the Bill and go to Parliament again at some future time. His Committee had recommended accordingly.

No. 4.

WATER HEATER SCIENCE.

The word science has for its meaning "Knowledge reduced to system," but the application of a scientific idea only, in the production of a practical and commercial appliance, is not always a success, there must be the combination of science and practice to produce the successful article.

These qualifications have been so welded together in our Laboratories and Works, that the claims of efficiency, durability, and practical usefulness, which our previous advertisements have expressed, are actual facts. Our representatives are busily demonstrating and booking orders for our New and Improved Water Heaters and Circulators which are now on the market, and we ask you to write us on any inquiry you may wish advice—our trained staff is at your disposal.



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Water Heater Specialists,

WARRINGTON and LONDON.

Mr. C. E. Hearson (the Chairman of the Works and Stores Committee) moved an instruction to the Parliamentary Committee of the Board to respectfully submit to the Joint Committee that the suggested curtailment of the Board's existing rights would inflict unnecessary expense on the ratepayers of the Metropolis; but that if, in spite of these considerations, the Committee adhered to their decision as being the only terms upon which Parliament would at present sanction abstraction of water from the Thames, the Board had no alternative but to accept their decision. In so doing, they urged upon Parliament the justice of reducting the payments proposed to be made to the Thames Conservancy. The amendment was rejected by 29 votes to 19; and the Law and Parliamentary Committee's recommendation was carried.

Co-operation between Employers and Employed.

In another part of the "JOURNAL," reference is made to the election of Mr. T. S. Clapham as President of the Keighley and District Chamber of Commerce. In the course of an interesting address delivered at the meeting of the Council on the 28th ult., he made the following remarks on the above subject: "The trade of the district had a goodly heritage. Its productions had long enjoyed a high reputation, both in this country and beyond the seas, for good workmanship and finish. This reputation must be kept; and it could only be kept by the continued co-operation of employers and employed, each endeavouring conscientiously to do a part in its achievement. The workshops and factories might be up-to-date and replete with the best and most modern tools and machinery; but unless they were worked by healthy, intelligent, and happy managers and workpeople, all would be in vain. The Chamber, therefore, would be doing well to continue its interest and efforts in the proper training of the young, both in school and workshop—in a word, zealous in the making of men as well as in the making of money; for, after all, the former was by far the higher ideal, and would endure when wealth had taken to itself wings and gone from their reach. Much help could be rendered to the worthy unemployed—of whom, happily, there were but few in the neighbourhood at present—by making use of the Labour Exchange, where he was convinced there was a wholesome and honest desire to bring together employer and employable for their mutual good."

Gas and Water Finance at Bury.—It was reported at a meeting of the Bury Town Council, held last Thursday, that the profits on the gas undertaking for the past year were £7710, compared with £7181 in the preceding year. At a meeting of the Bury and District Joint Water Board, the same afternoon, it was stated that the total capital outlay on the undertaking up to date was £1,500,000. Water is supplied to nine different authorities, which include a population of 185,000. The expenditure on the past year totalled £74,294. It was announced that the estimates for the ensuing year would ensure a welcome reduction in the precepts of the various authorities represented on the Board.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

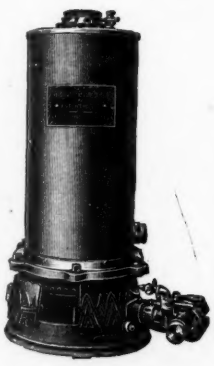
The position of Edinburgh as a commercial and industrial centre is a subject which is at present receiving some attention, as the aftermath of a town-planning exhibition which was held in the city recently. The other day, a conference on the subject was held (under the auspices of the Edinburgh Merchants' Guild), at which statements were made regarding certain industries; and in reply to these statements, a letter by Treasurer Leishman was published in the "Scotsman" on Monday of this week. In his letter, the Treasurer stated that "one of the particular references was to the gas-meter industry in Edinburgh. This industry is one of some importance in Edinburgh; and, like most other industries, it has had to encounter trials and difficulties of various kinds. One of the most formidable competitors that the gas industry has had to meet has been the enormous development of a new and powerful rival in electricity. In spite of this, it cannot be said that the gas industry is ruined; and, in particular, I think it may fairly be stated that the gas-meter industry of Edinburgh has more than held its own. I have no right to mention individual firms; and still less can I print private information. But it is permissible to say that Edinburgh is proud to number within its borders several of the leading gas-meter firms of the world. The product of these firms is sent to all parts of Great Britain, and, indeed, to the farthest portions of the civilized globe—including the Far East and our Colonies. In spite of the vast potentialities of electricity, the following incomplete figures, I think, prove my contention. They do not by any means cover the entire output of the gas-meter makers of Edinburgh, and relate to those meters tested by the City of Edinburgh Gas-Meter Testing Department since the Sale of Gas Act was introduced.

[First meter tested Sept. 16, 1861.]

1861 to 1871	34,537	Average per year.
1871 to 1881	38,071	
1881 to 1891	35,674	
1891 to 1901	56,036	
1901 to 1902	80,338	Yearly figures.
1902 to 1903	84,947	
1903 to 1904	93,123	
1904 to 1905*	79,470	
1905 to 1906	98,363	
1906 to 1907	87,616	
1907 to 1908	86,025	
1908 to 1909	87,388	
1909 to 1910	89,027	

* Ten months only. The financial year changed to May 15.

There was a discussion in the Glasgow Town Council on Thursday on the Standing Order of the Council which applies to conditions of



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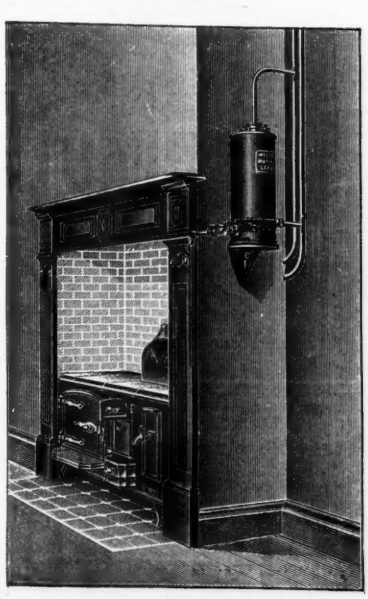

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contracts. The subject was brought up by a minute of the Gas Committee with reference to offers for block tin, and the acceptance of tenders for the supply of galvanized corrugated sheets, in regard to which it was stated that the decision of the Committee to accept a certain offer was given by the casting vote of the Chairman. Mr. Nelson said that the minute brought them face to face with the difficulty which had arisen in consequence of the alteration of the Standing Order so as to provide that, in cases of contracts with the Corporation, the persons or firms contracting shall not only pay the standard rate of wages to all competent workers for all classes of work, but shall pay to all competent male workers employed by them a minimum wage of not less than 21s. per week. It could not be doubted that the sympathy of the Corporation and of the community was with the section of wage-earners whose earnings were at or under £55 per annum in their struggle to secure improved pay; but the policy of the Corporation in enforcing a bye-law stipulating for payment by all contractors of a minimum wage was, in the light of recent experience, open to question. The Corporation might give a lead in granting a fair minimum to their own employees; but they could not compel the adoption of their own standard. This had been brought home to them recently in their commercial departments; tenderers for classes of goods that the Corporation could not do without having declined to quote so long as the recently-enacted bye-law remained in force. Bailie Alston thought that the new bye-law had not yet had a fair working trial, nor had it resulted in the best class of firms being debarred from tendering for Corporation work. Mr. W. F. Anderson was of opinion that, in passing the bye-law, they had, as he anticipated, run their head against a stone wall. They were now in a preposterous position, because they asked firms to apply to Corporation contracts a standard that no member of the Corporation would think of applying to his own business. Mr. Nelson said that his purpose had been served in drawing attention to this aspect of the subject; and he was not prepared to move an amendment to the minute of the Committee.

A writer in the "Glasgow Herald" of yesterday, over the signature of "Equity," expresses himself to the following effect: "I have perused with interest the various letters in your columns requesting that anything belonging to William Murdoch, the introducer of steam traction, inventor of gas lighting, &c., in the possession of your readers, might be sent to the Glasgow Historical Exhibition. A compliance with this is very desirable; and it is to be hoped that some response will result. From personal knowledge, however, the present writer doubts if anything more is now traceable outside of the objects contained in the collection made by the late Sir Richard Tangye. Beyond the modest salary allowed him by Boulton and Watt, no money whatever seems to have been paid to Murdoch. Certainly not a penny was ever received from those who appropriated the fruits of his genius and labour, and used same to their own advantage. The benefits in this way having passed direct to the community, it would appear that in such circumstances the best way to recognize and express our sense of the worth and services of Murdoch would be for some public body (such as the Institution of Engineers and the Association of Gas Managers) to take the lead in creating a fund bearing his name, to provide a superior and technical education (1) for the descendants of William Murdoch, or, failing this, (2) for young men (*a*) bearing the surname of Murdoch, and, should surplus funds permit, (*b*) for other young men whose fathers and grandfathers have been mechanical engineers or gas managers, or connected with allied industries. It would only be an act of common justice were the above acted upon. Such a course, if it did not altogether efface the stigma upon the pretensions of our moral code and the claims of a superior civilization, would at least show that we were conscious of the wrong done in the past by the cupidity and selfishness of others, and that we ourselves did what was still in our power to give some measure of redress, if not of actual reparation. This is very desirable, and would be acceptable to many of the descendants of Murdoch, most of whom have enjoyed but very moderate, and oftentimes very indifferent, prosperity in the various walks of life, in which they have conducted themselves with credit, and in some instances with indications of marked ability. . . . Can nothing be done by our industrial captains, whose good fortune has been made possible by Murdoch, to remove this stain from the escutcheon of our industrial system?"

In the Fraserburgh Town Council on Thursday, Mr. John Anderson said that, as the transfer of the gas undertaking to the Town Council was practically accomplished as at May 1, he thought it advisable that a permanent Gas Committee be constituted, as questions such as the appointment of officials would have to be attended to. Provost Finlayson suggested that the present Gas Committee be retained as an interim Committee till the time should come round for the appointment of all the Committees of the Council. This was agreed to.

The meeting of the Kirkcaldy Gaslight Company, to which I referred a fortnight ago, was held on Tuesday. It was unanimously agreed that the Company should be wound up voluntarily, and that Mr. W. L. Macindoe, solicitor, Kirkcaldy, the Company's Secretary, be appointed Liquidator. Intimation was made that a distribution of the funds of the Company, to the amount probably of £9 per share, will be made as soon as the purchase-money is received from the Corporation. A note of the expenses of the arbitration has not yet been made up.

Omagh Urban District Council Gas Undertaking.—At the monthly meeting of the Omagh District Council on Monday last week, Messrs. Brandon and Co.'s annual report and balance-sheet were read, and considered to be highly satisfactory. The net profit was £1605, or an increase of £239 over the previous year; and the unaccounted-for gas was reduced by almost 5 per cent. The production of gas per ton of coal was increased by 461 cubic feet. The sales of coke showed an increase of ¾ cwt. per ton of coal; while the wages bill was £48 less. In moving the adoption of the report, the Chairman expressed himself as highly pleased, and attributed to Mr. O'Callaghan's management the satisfactory result shown by the report and accounts submitted.

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CURRENT SALES OF GAS PRODUCTS.

[For Table of "Tar Products Prices," see p. 403.]

Sulphate of Ammonia.

LIVERPOOL, *May* 6.

With the commencement of the new month, the market again assumed a quiet tone; and throughout the past week prices have gradually given way to a further extent. The demand for home consumption is now drawing to a close; and, although stocks in this country are small, the supply has been ample to meet all requirements for export. The transactions reported have been at somewhat erratic figures; but the nearest values for prompt delivery to-day are £13 8s. 9d. per ton f.o,b. Hull, £13 10s. per ton f.o.b. Liverpool, and £13 12s. 6d. per ton f.o.b. Leith. There has been some inquiry for delivery over the second half of this year, as well as for the early months of 1912; but manufacturers' ideas of value and those of buyers have been too divergent to admit of business.

Nitrate of Soda.

The market for this article has remained very steady, and spot quotations are maintained at 9s. 9d. per cwt. for ordinary and 10s. for refined quality.

LONDON, *May* 8.

Tar Products.

The markets for tar products have remained steady during the past week. Although the market in pitch is decidedly steady, the prices are practically unchanged; but there is an upward tendency. Benzols continue in about the same position, and there is little business doing. There has not been much inquiry for crude carbolic; but it has had little effect on the market. Solvent naphtha is steady; and heavy naphthas are very firm.

The average values during the week were: Tar, 17s. 9d. to 21s. 9d., *ex* works. Pitch, London, 36s. to 36s. 6d.; east coast, 35s. 6d. to 36s. 6d.; west coast, Manchester, 35s. 6d. to 36s., Liverpool, 36s. to 36s. 6d., Clyde, 36s. to 36s. 6d. Benzol, 90 per cent., casks included, London, 8¾d. to 9¼d.; North, 8½d. to 9d.; 50-90 per cent., casks included, London, 9d. to 9¼d.; North, 8½d. to 9d. Toluol, casks included, London, 9¾d.; North, 9½d. to 9½d. Crude naphtha, in bulk, London, 4d. to 4½d.; North, 3½d. to 3½d.; solvent naphtha, casks included, London, 11½d. to 1s.; North, 10½d. to 11d.; heavy naphtha, casks included, London, 1s. to 1s. 0½d.; North, 10½d. to 11d. Creosote, in bulk, London, 2¼d. to 2⅜d.; North, 1⅞d. to 2d. Heavy oils, in bulk, 2⅝d. to 2¾d. Carbolic acid, 60 per cent., casks included, east coast, 1s. 7d. to 1s. 8d.; west coast, 1s. 6½d. to 1s. 7½d. Naphthalene, £4 10s. to £8 10s.; salts, 40s. to 42s. 6d., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has been very little doing during the past week, and prices have declined slightly at all ports. Actual Beckton is quoted at £13. Outside London makes are £12 17s. 6d.; Leith, £13 15s.; Hull, £13 11s. 3d. to £13 12s. 6d.; Liverpool, £13 12s. 6d.; and Middlesbrough, £13 11s. 3d. to £13 12s. 6d.

COAL TRADE REPORTS.

Northern Coal Trade.

The coal trade in the North is active, and the opening of shipments to the ports of the Upper Baltic has increased the demand. In steam coals, the tone is a little easier, and best Northumbrians are from about 10s. 7d. to 10s. 10½d. per ton f.o.b. Second-class steams are from 9s. to 9s. 3d. per ton; and for steam smalls, the inquiry is fair, at from 5s. to 6s. 3d. The general demand for these classes of coals is sustained; but it cannot be said to be brisk, though the production is well taken up. In the gas coal trade, there is a full export demand, which makes up for the lessened consumption at home; and there is a good inquiry for Durham coal for other uses. Gas coals are steady in price. The usual classes vary from 9s. per ton f.o.b. for seconds up to 9s. 7½d. and 9s. 9d. for best; and for "Wear specials," the quotation is from 10s. 6d. to 10s. 9d. There are one or two contracts in the market, and one is reported as settled for a German gas company for about 18,000 tons at a price of near 9s. 8d. f.o.b. in the Tyne for best kinds. Other sales forward for cargoes are reported on a similar basis of prices. A contract for gas coals for Turin is just announced as settled for delivery over the rest of this year, at prices that are believed to be from 16s. 1d. to 16s. 3d. per ton delivered. In coke, the market is easier. Good gas coke is from 12s. 10½d. to 13s. The production of gas coke is now less; and it is believed that the f.o.b. prices just quoted may be steadied.

Scotch Coal Trade.

There is a better home demand. Large coal is in request. Small varieties are dragging in the market. There is a good demand for steam coal. The prices now quoted are: Ell, 8s. 9d. to 9s. 9d. per ton f.o.b. Glasgow; splint, 9s. 6d. to 9s. 9d.; and steam, 9s. to 9s. 3d. The shipments for the week amounted to 337,995 tons—a decrease of 18,371 tons upon the previous week, but an increase of 20,959 tons upon the corresponding week last year. For the year to date, the total shipments have been 4,918,955 tons—a decrease upon the corresponding period of 116,720 tons.

Additional Capital for the Tonbridge Gas Company.—Last Tuesday, Messrs. Martin and Sanderson sold £1000 of "E" stock of the Tonbridge Gas Company. The £50 lots fetched £110 to £112 (the latter being a record price), and the £20 lots realized prices ranging from £43 10s. to £44 10s. The stock will rank for a dividend at the rate of 10½ per cent. per annum from the 1st of July next.

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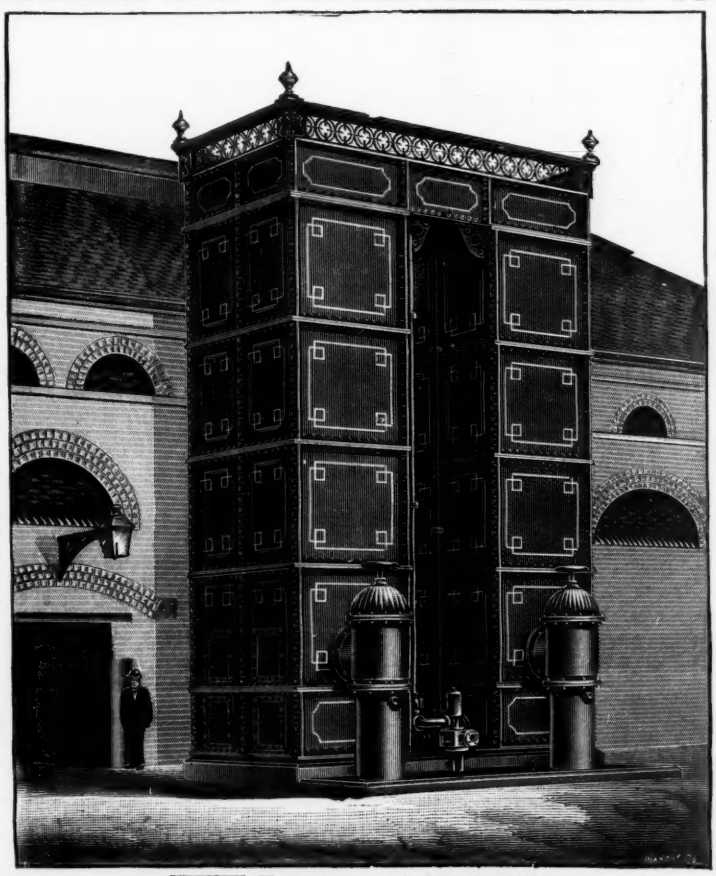

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EAST HULL,
KINGSTON-ON-THAMES,
BRISTOL,
WALKER AND WALLSEND,
and other Works.

Reductions in the Price of Gas.

At a meeting of the Malvern Urban District Council last Tuesday, the recommendation of the Gas Engineer (Mr. W. J. Rendell-Baker) to the Gas Committee to reduce the price of gas in Malvern for power purposes by 10d. per 1000 cubic feet was confirmed. The Gas Committee of the Dukinfield Corporation recently passed a resolution recommending the Council to reduce the price of gas from 2s. 6d. to 2s. 4d. per 1000 cubic feet; and the Council have adopted the recommendation. The Directors of the Rossendale Union Gas Company will reduce the price of gas from the 1st of July as follows: Under 500,000 cubic feet per quarter, 3s. 1d. per 1000; above this quantity, 3s. per 1000, or 1d. reduction. For cooking, heating, and motive power, the price will be 2s. 6d., or a reduction of 3d. The usual discount of 2½ per cent. will be allowed if accounts are paid during the first month after the expiration of the quarter. At last Wednesday's meeting of the Manchester City Council, it was resolved *nem. con.* to adopt a recommendation of the Gas Committee that, on and after Sept. 30 next, consumers within the city having prepayment meters should be supplied with 33 cubic feet instead of 30 cubic feet of gas for 1d.; and that the users of these meters outside the city area should have 28 cubic feet, instead of 25, for this amount.

Gas Exhibition at Carlisle.

An exhibition under the auspices of the Carlisle Gas Committee, was last week opened in the County Hall by the Mayor (Sir Benjamin Scott), who was supported by several councillors and the Gas Engineer (Mr. H. Bloor). Four firms exhibited their goods—the Davis Gas-Stove Company, Messrs. R. & A. Main, Messrs. John Wright and Co., and the Richmond Gas Stove and Meter Company. The Mayor said that, as Mayor and as an old member of the Gas Committee, he had pleasure in inaugurating the exhibition. In doing so, he was reminded that it was 26 years since the first exhibition of the kind was held in Carlisle with the object of drawing the attention of the citizens and the inhabitants of the adjoining district to the advantages of gas for cooking purposes. At that time, his old friend Mr. Hepworth was Gas Manager in Carlisle. No doubt a good many present remembered Mr. Hepworth, and how much the city owed to him in those good old days in connection with the introduction of gas for cooking purposes. That exhibition was held in the year that he (Sir Benjamin) had first the honour of being Mayor of the city. The exhibition proved popular and successful. In a subsequent year, when he was again the city's Chief Magistrate, Mr. Hepworth had the honour of being President of the Gas Institute, who came to Carlisle and held their annual meeting. In those days gas had hardly any competitors; but now the ingenuity of man had provided competitors, and the Gas Committee realized how necessary it was to show the public what an enormous advantage gas possessed for many purposes. There was a very large field now for the use of gas, especially as a cooking agent; and he believed that the only way to purify the atmosphere in great towns would be to do away with coal-fires and warm houses with gas, which would add to the pleasures of existence and reduce mortality more than anything else. The Gas Committee supported this exhibition not from any selfish motives, for the gas-works belonged to the citizens themselves.

Cardiff Gas Company and Technical Classes.—At a meeting of the Cardiff Technical School Committee last Wednesday, the Superintendent of the school (Mr. C. Coles) reported that the Cardiff Gas Company were so pleased with what had been done in connection with the class in "Gas Supply," that it had been decided to offer prizes on the results of the session's work.

Stand-By Supplies at Barnstaple.—The question of the provision to be made under the Barnstaple Gas Company's Provisional Order for stand-by supplies of gas, was referred to at the last meeting of the Town Council. It was reported that Mr. Ffinch, the Solicitor to the Company, had had an interview with the Mayor and Town Clerk, and informed them that the Board of Trade would not agree to the suggested alteration of section 22 of the Order, which had been agreed upon by the Company and the Council. Mr. Ffinch suggested that the words "or a supply of electricity" should be eliminated from the section, which would then read as follows: "Notwithstanding anything contained in the Gas-Works Clauses Act, 1871, or any other Act, a person shall not be entitled to receive from the undertakers a supply of gas for any premises for which he has at the same time a supply of gas from an installation other than that of the undertakers, unless he shall have agreed to pay to the undertakers such minimum annual sum as will give them a reasonable return on the capital expended and will cover other standing charges incurred by them in order to meet the possible maximum demand for these premises; and the sum agreed to be paid shall be determined in default of agreement by arbitration in manner provided by the Arbitration Act, 1889." Mr. Barrett proposed that the matter be referred to Committee for further consideration. Section 22, he said, had been eliminated from the Order; and additional clauses had been inserted. These had not been considered by the Council; and it would be wise to look into them before agreeing to the present proposal. Mr. Barrett's proposition was carried.

It was Mr. Ernest L. Burton (not Mr. A. L. Perkin, as stated by mistake) who gave evidence on the Chesham Gas Bill, as reported in the "JOURNAL" last week.

The Dowson and Mason Gas Plant Company, Limited, of Levenshulme, Manchester, have secured an order for annealing plant, consisting of eight gas-fired Weardale bogie annealing furnaces, with the necessary Duff gas-producers, gas-tubing, &c., for the Singer Manufacturing Company, Limited, of Clydebank.

The New Mills Urban District Council have recently placed an order with Messrs. R. & J. Dempster, Limited, for an improved Dellwik type of carburetted water-gas plant, in which the advantage of the Dellwik principle as applied to the generator is fully utilized, enabling either high or low grade carburetted water gas to be produced.

The CANNON "SIMPLEX" Interchangeable PLATE RACK

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Enamelled Back Plate.

Illustration showing Rack in Position for use.

Illustration showing Rack being slided at back when not required.

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Equally adaptable to any Cooker.
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Situations Vacant.

HIGH PRESSURE GAS LIGHTING ENGINEER. Box 453. T. B. Browne's Advertising Offices.
SECRETARY AND GAS MANAGER. Farnham Gas and Electricity Company.
DRAUGHTSMAN. No. 5400.
WORKING MANAGER. No. 5396.
FOREMAN GAS-STOVE FITTER. No. 5397.
CANVASSER, &c. No. 5398.
CLERK AND COLLECTOR. Cannock, &c., Gas Company.
SHOW-ROOM MANAGER. No. 5401.

Situations, &c., Wanted.

ENGINEER IN CHARGE OR REPRESENTATIVE. No. 5391.
MANAGERSHIP (WITH INVESTMENT). No. 5402.
REPRESENTATIVE OR AGENT (France). G. Margueritte, Paris.
SECRETARY. No. 5395.
SULPHATE PLANT REPAIRER, &c. Davies, Shepherd's Bush.

Stocks and Shares.

ALDERSHOT GAS, WATER, AND DISTRICT LIGHTING COMPANY. By Auction. May 30.
BISHOP'S STORTFORD, HARLOW, AND EPPING GAS AND ELECTRICITY COMPANY. By Auction. May 25.
DORKING GAS COMPANY. By Auction. May 30.
EAST KENT WATER COMPANY. By Auction. May 23.
WANDSWORTH AND PUTNEY GAS COMPANY. By Auction. May 23.
WEST KENT GAS COMPANY. By Auction. May 23.
YORKTOWN AND BLACKWATER GAS COMPANY. By Auction. May 23.

TENDERS FOR

Plant, &c. (Second-Hand), For Sale.

BRIDGE PIPES, ASCENSION PIPES, MOUTHPIECES, &c. John Adams and Sons, Newcastle-on-Tyne.

Coal and Cannel.

BANGOR (N.W.) GAS DEPARTMENT. Tenders by May 17.
BRIDGNORTH GAS DEPARTMENT. Tenders by May 13.
BURTON-ON-TRENT TOWN COUNCIL. Tenders by May 24.
GLOUCESTER GASLIGHT COMPANY. Tenders by May 29.
GUILDFORD GASLIGHT COMPANY. Tenders by May 30.
LEIGH GAS AND WATER DEPARTMENT. Tenders by May 17.
MANCHESTER GAS DEPARTMENT. Tenders by May 22.
OMAGH GAS DEPARTMENT. Tenders by May 31.
SAFFRON WALDEN GAS AND WATER DEPARTMENTS. Tenders by May 27.
SKIPTON URBAN DISTRICT COUNCIL. Tenders by May 27.
SMETHWICK GAS DEPARTMENT. Tenders by May 24.
TIVERTON TOWN COUNCIL. Tenders by June 3.

Gas-Works Concessions and Extensions.

ODESSA CORPORATION. Tenders by June 10, 23.

Governor.

BRITON FERRY URBAN DISTRICT COUNCIL.

Lighting Tunnel Works, &c.

RHONDDA URBAN DISTRICT COUNCIL. Tenders by May 19.

Machinery and Plant, &c. (Water Works).

RHONDDA URBAN DISTRICT COUNCIL. Tenders by May 19.

General Stores (Tools and Ironmongery, Lubricants, Paints, Lime, Copper Cables, &c., Brass and Copper Tubes and Fittings, Lead Gas Pipe, Sulphuric Acid, Benzol, &c.).

DARWEN GAS DEPARTMENT. Tenders by May 20.
LEIGH GAS AND WATER DEPARTMENT. Tenders by May 17.
RHONDDA URBAN DISTRICT COUNCIL. Tenders by May 19.
WIGAN GAS DEPARTMENT. Tenders by May 15.

Mantles, Chimneys, and Globes.

WEST HAM EDUCATION COMMITTEE. Tenders by May 15.

Meter (Station).

BRITON FERRY URBAN DISTRICT COUNCIL.

Oxide of Iron.

BELFAST GAS DEPARTMENT. Tenders by May 18.

Pipes (Cast and Wrought), &c.

DARWEN GAS DEPARTMENT. Tenders by May 20.
LEIGH GAS AND WATER DEPARTMENT. Tenders by May 17.
WIGAN GAS DEPARTMENT. Tenders by May 15.

Spent Oxide Residue.

No. 5399.

Tar and Liquor.

BURTON-ON-TRENT TOWN COUNCIL. Tenders by May 24.
DARWEN GAS DEPARTMENT. Tenders by May 20.
WIGAN GAS DEPARTMENT. Tenders by May 15.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending May 6. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast.		Glasgow.
					Liverpool.	Manchester.	
Tar crude	per ton	—	18/6 21/6	18/6 22/-	18/6 21/-	18/9 21/3	—
Pitch	,,	37/-	35/6 36/-	36/-	36/6	36/-	35/6
Benzol, 90%	per gallon	—	-/9	-/9	-/9¼	-/9	-/9
Benzol, 50-90%	,,	—	-/9¼ -/9½	-/9½	-/8 -/8¼	-/8¼	—
Toluol, 90%	,,	—	-/9¾ -/10	-/10	-/10	-/10	-/10
Crude naphtha, 30%	,,	—	-/3¾	-/4	-/3¼ -/3½	-/3½	—
Light oil, 50%	,,	—	-/3½	-/3¾ -/4	-/3 -/3⅜	-/3¼	—
Solvent naphtha, 90-160	,,	—	-/10½	-/10	-/10	-/10½	-/11
Heavy naphtha, 90-190	,,	—	-/11	-/11⅛	-/11¼	-/11¼	-/11
Creosote in bulk	,,	-/2½	-/2⅛	-/2	-/2⅛	-/2 1/16	-/1⅞
Heavy oils	,,	—	-/2⅝ -/2¾	-/2¼	-/2¾	-/2¾	-/2⅝
Carbolic Acid, 60's	,,	—	1/7½	1/7	1/7	1/7	1/8
Naphthalene, crude drained salts	per ton	—	42/6 45/-	40/- 42/6	47/6	47/6 50/-	—
,, pressed	,,	—	60/-	63/-	60/-	60/- 72/6	—
,, whizzed	,,	—	—	—	70/- 72/6	60/- 75/-	63/-
Anthracene	per unit	-/2	-/1¼	-/1½	-/1½	-/1¼	—

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

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All Communications, Remittances, &c., to be addressed to
WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.
Telegrams: "GASKING, LONDON." Telephone: P.O. 1571a Central.

OXIDE OF IRON.

O'NEILL'S OXIDE
For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
PALMERSTON HOUSE,
OLD BROAD STREET, LONDON, E.C.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, LONDON, E.C. "Volcanism, London."

BROTHERTON & CO., LIMITED,
Offices: City Chambers, LEEDS.
Correspondence invited.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 45 & 47, Westminster Bridge Road, LONDON, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS, AND GOVERNORS.
REPAIRS RECEIVE PROMPT ATTENTION.
Telephones: 815 Oldham, and 2412 Hop, London.
Telegrams—
"BRADDOCK, OLDHAM," and "METRIQUE, LONDON."

OXIDE OF IRON (BOG ORE)
ANY QUANTITY. ANY PORT. ANY STATION.
DONALD M'INTOSH,
110, CANNON STREET, LONDON.

SPENCER'S PATENT HURDLE GRIDS.

THE very best Patent Grids for Holding Oxide Lightly.
See Illustrated Advertisement, April 4, p. 75.

OXIDE OF IRON.
SPENT OXIDE PURCHASED.
BALE'S FIRE CEMENT.
PAINT FOR GAS-WORKS.
"KLEENOFF," THE COOKER CLEANER.
BALE & CHURCH,
5, CROOKED LANE, LONDON, E.C.

SULPHURIC ACID.

SPECIALLY prepared for the Manufacture of SULPHATE OF AMMONIA.
SPENCER CHAPMAN & MESSEL, LTD.,
with which is amalgamated WM. PEARCE & SONS, LTD., 36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.
Telegrams: "HYDROCHLORIC, LONDON."
Telephone: 341 AVENUE.

ROBERT DEMPSTER & SONS, Ltd., Contractors for Complete CARBONIZING PLANTS and every description of GAS APPARATUS and ELEVATING and CONVEYING PLANT, Rose Mount Iron-Works, Elland.

DUTCH OXIDE OF IRON.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

THE First Dutch Bogore Co., Ltd.,
NYMEGEN, HOLLAND.
General Manager (for England and Wales)—
CHARLES E. FRY, SUTTON, SURREY,
General Manager (for Scotland)—
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

TAR WANTED.

THOMAS HORROCKS & SONS, LTD.,
Albert Chemical Works, BRADFORD,
MANCHESTER,
Pitch, Creosote, Brick and Fuel Oils, Benzol, Solvent Naphtha, Carbolic, Sulphate of Ammonia.

SULPHURIC ACID.

SPECIALLY prepared for Sulphate of AMMONIA Makers by
CHANCE AND HUNT, LIMITED,
Works: Oldbury, Wednesbury, and Stafford.
Address Correspondence and Inquiries to Oldbury, Worcs.
Telegrams: "Chemicals, Oldbury."

CORONATION, JUNE 22, 1911.

GAS Engineers should examine at once and send in to be put into thorough order all Gas Illumination Devices, as well as place orders for additional requirements with
JAMES MILNE AND SON, LIMITED,
EDINBURGH, LONDON, GLASGOW, LEEDS.

ENQUIRIES SOLICITED.

FOR Gas-Works Plant of Every De-scription; also SULPHATE OF AMMONIA and SULPHUR RECOVERY PLANTS,
C. & W. WALKER, LIMITED,
DONNINGTON, NEWPORT, SALOP.

D. ANDERSON AND COMPANY,
GAS LIGHTING ENGINEERS AND CONTRACTORS,
18 & 20, FARRINGDON ROAD, LONDON, E.C.
Telegrams: "Dacolight London." Telephone: 2336 Holborn.

HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.
Twice as rich as Bog Ore.
Gives no back Pressure.
The Cheapest in the Market.
Read Holliday and Sons, Ltd., Huddersfield.

JOHN RILEY & SONS, Chemical Manu-facturers, Hapton, near Accrington, are MAKERS of Special SULPHURIC ACID, for Sulphate of Ammonia Making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol, which has now been used for upwards of 50 years. References given to Gas Companies.

GAS OILS.

MEADE-KING, ROBINSON, & CO., Represent the Strongest Independent Refineries in America; also Petroleum Spirit for Gas Enrichment. 18, Exchange Street, Manchester, and Tower Building, 22, Water Street, Liverpool.

IT is worth Your While to Buy Direct from the RELIANCE LUBRICATING OIL COMPANY GUARANTEED ANTI-CORROSIVE LUBRICANTS—viz., Motor Waggon Oil, 1s.; Motor Car Oil, 1s. 6d.; Engine, Cylinder, and Machinery Oils, 1s.; Axle Oil, 10½d.; Exhauster Oil, 10d.; Special Cylinder Oil, 1s. 4d.; 630 T Cylinder, 1s. 9d.; Special Engine Oil, 1s. 4d.; Gas Engine and Oil Engine Oil, 1s. 6d.; Refrigerator, 1s. 9d.; Renown Engine Oil, 11½d.; and Astral Disinfectant, 2s. 6d. per gallon. Barrels free, carriage paid. Solidified Oil, 25s. cwt.
The Reliance Lubricating Oil Company, 19 & 20, Water Lane, Tower St., London, E.C. Agents wanted.

SULPHURIC ACID for Sale, specially suitable for making Sulphate of Ammonia.
Brotherton and Co., Ltd., Chemical Manufacturers. Works: Birmingham, Leeds, Sunderland, and Wakefield.

COAL TAR wanted.
Brotherton and Co., Ltd., Tar Distillers. Works: Birmingham, Glasgow, Leeds, Liverpool, Sunderland, and Wakefield.

AMMONIA.
Consumers in any form are invited to correspond with Chance and Hunt, Ltd., Chemical Manufacturers, Oldbury, Worcs.

AMMONIACAL Liquor wanted.
Brotherton and Co., Ltd., Ammonia Distillers. Works: Birmingham, Glasgow, Leeds, Liverpool, Sunderland, and Wakefield.

PATENTS AND TRADE MARKS
PUBLICATIONS, "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d. "SUBJECT-MATTER of PATENTS," 6d.
MEWBURN, ELLIS, & PRYOR, Chartered Patent Agents, 70 & 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

SULPHATE OF AMMONIA SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We guarantee promptness with efficiency for Repairs.
Joseph Taylor and Co., Central Plumbing Works, Bolton.
Telegrams: "Saturators, Bolton." Telephone 0848.

GAS PLANT for Sale—We can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
Firth Blakeley, Sons, and Company, Limited, Church Fenton, near Leeds.

J. E. C. LORD, Ship Canal Tar Works, Weaste, Manchester. Pitch, Creosote, Benzols, Toluol, Naphtha, Pyridine, all kinds of Cresylic Acid, Carbolic Acid, Sulphate of Ammonia, &c.

SULPHURIC ACID — Specially pre-pared for Sulphate of AMMONIA and BENZOL Recovery Plants. John Nicholson & Sons, Ltd., Hunslet Chemical Works, Leeds. Tele.: "Nicholson, Leeds." Telephone: (Two lines), Nos. 2420 and 2421.

"GAZINE" (Registered in England and Abroad). A radical Solvent and Preventative of Naphthalene Deposits, and for the Automatic Cleaning of Mains and Services.
It is also used for the enrichment of Gas.
Manufactured and supplied by C. Bourne, West Moor Chemical Works, Killingworth, or through his Agent, F. J. Nicol, Pilgrim House, Newcastle-on-Tyne.
Telegrams: "Doric," Newcastle-on-Tyne. National Telephone No. 2497.

WANTED—Tar and Ammoniacal Liquor. Any Quantity.
Grindley and Company, Limited, Rawcliffe, near Goole, Yorkshire.

"GUIDE to Patents, Trade Marks and DESIGNS," 1910. 4th Edition. Contains concise information on British, Colonial, and Foreign Patents, &c. All Inventors and those interested should send for free copy to J. S. Withers & Spooner, Chartered Patent Agents, 323, High Holborn, London. 'Phone.: 480 Holborn. Telegrams: "Improvably, London."

AMMONIACAL Liquor wanted.
Chance and Hunt, Ltd., Chemical Manufacturers, Oldbury, Worcs.
Telegrams: "Chemicals."

GAS-WORKS requiring Extensions should Communicate with FIRTH BLAKELEY, SONS, AND CO., LIMITED, Dewsbury, who make a Speciality of Catering for the Smaller Gas Concerns. Prices Reasonable; quality and results, the *best*. Satisfaction Guaranteed.

FOR SALE.

SYPHON PUMPS
of the very latest improved design.
Apply early
JAMES MILNE AND SON, LIMITED,
EDINBURGH, LONDON, GLASGOW, LEEDS

AMMONIA Waste Liquor Disposal.
Purification Plant.
Results Guaranteed. No Working Costs.
John Radcliffe, Chemical Engineer, East Barnet.

OUR DUTY—YOUR PLEASURE.

WHENEVER convenient to you, kindly ask us to furnish Particulars of
HIGH PRESSURE LIGHTING PLANT.
JAMES MILNE AND SON, LIMITED,
EDINBURGH, LONDON, GLASGOW, LEEDS.

PATENT SATURATOR.

GREAT Improvement in the Ammonia Distributing Pipe to prevent Bulging, Bursting, and to ensure more equal Distribution of the Ammonia Gas into the Liquor (Great Economy).
Particulars of Leadburner P. J. Davies, 118, Galloway Road, Shepherd's Bush.

GAS AND WATER RENTAL CLERK AND GAS AND WATER COLLECTOR. No. 5379.

APPLICANTS are Thanked and In-formed that the above POSITIONS HAVE NOW BEEN FILLED. Please note that this will be the only intimation.

SULPHATE of Ammonia Saturators and Lead Work (Repairs, &c.). Leadburner and Chemical Plumber of Great Experience. Workmanship Guaranteed. Disengaged. Any Distance, with or without Plant. Has worked for Principal Firms, with 20 Years' References. Erecting. Jobbing done, &c.
Davies, 118, Galloway Road, Shepherd's Bush.

ENGINEER, A.M.Inst.Mech.E., seeks Position as REPRESENTATIVE or ENGINEER IN CHARGE. Speaks Three Languages. Recently Completed the Supervision of the Construction of a large Gas-Works Abroad. Able to control workmen. Works experience. Good Appearance. First-Class Testimonials.
Address No. 5391, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

SECRETARYSHIP.

ADVERTISER (Age 30) desires Post as SECRETARY to Gas or other Company. Thorough knowledge of work.
Address No. 5395, care of Mr. King, 11, Bolt Court Fleet Street, E.C.

GENERAL Agent of Factories for Articles concerning Gas Industry, having Office and Store in Paris, wishes REPRESENTATIONS exclusively for France.
Address G. Margueritte, 11, Rue St. Augustin, Paris.

WANTED, by a Gentleman recently returned from the U.S.A., the MANAGEMENT of a small Works where small CAPITAL could be INVESTED. Ten Years' Experience in all Departments of Works, Distribution, and New Business.
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FARNHAM GAS AND ELECTRICITY COMPANY.

WANTED, a Secretary and Gas Manager. Present Annual Make, 60 Millions. Commencing Salary, £250 a Year.
Applications, stating Age and previous Experience, to be made in Candidate's own Handwriting, accompanied by not more than Three *copies* of recent Testimonials, which will not be returned, and addressed to the Chairman, A. J. Nash, Esq., South Street, Farnham, Surrey.
Canvassing any of the Directors by or on behalf of any Candidate will disqualify.

WANTED, a Working Manager for a Gas Works in County Durham. Annual make, 24 Millions. Must be used to Regenerators, and a good Main and Service Layer. Salary, £150 a Year, with Free House, Coals, and Gas.
Apply, by letter, stating Age, and giving References and full Particulars of Experience, &c., to No. 5396, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED, a Show-Room Manager. Fully competent. Highest References.
Apply, by letter, stating Wages expected, to No. 5401, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

HIGH-PRESSURE GAS LIGHTING.

A LEADING Firm of Manufacturers requires the services of a First Class Engineer, with Commercial Training and a Practical Experience of High-Pressure Gas Lighting. Liberal Terms will be offered to a suitable Man with a connection among Gas Companies.
State terms, previous Experience, and Age, to Box 453, T. B. Browne's Advertising Offices, 163, Queen Victoria Street, London, E.C.

CANNOCK, HEDNESFORD, AND DISTRICT GAS COMPANY, LIMITED.

WANTED, Young Man as Clerk and Collector with thorough knowledge of Gas Office Work, including Ordinary and Prepayment Rentals.
Apply, stating Age, Experience, and Salary required, also enclosing *copies* of Two recent Testimonials, to T. A. Nicholls, Secretary, Gas-Works, Cannock.

DRAUGHTSMAN Wanted. Smart, accustomed to Gas-Works Plant, Steel Buildings, and General Structural Steelwork.
Apply by letter, stating Age, Experience, and Salary required, to No. 5400, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.